BULLETIN

OF THE

TORREY BOTANICAL CLUB

VOL. 44

FOUNDED BY WILLIAM HENRY LEGGETT, 1870

EDITOR

ALEXANDER WILLIAM EVANS

ASSOCIATE EDITORS

JEAN BROADHURST
JAMES ARTHUR HARRIS
MARSHALL AVERY HOWE
WILLIAM GEORGE MARQUETTE
HERBERT MAULE RICHARDS
ARLOW BURDETTE STOUT
NORMAN TAYLOR

NEW YORK
1917
PUBLISHED FOR THE CLUB
THE NEW ERA PRINTING COMPANY
LANCASTER, PENNSYLVANIA

NU

VOL. 44 JANUARY 1917 NO. 1

FEB 14 1917
UNIV. OF MICH. LIBRARY

BULLETIN

OF THE

TORREY BOTANICAL CLUB

Edited

ALEXANDER WILLIAM EVANS

Associate Editors

JEAN BROADHURST
JAMES ARTHUR HARRIS
MARSHALL AVERY HOWE
MICHAEL LEVINE
WILLIAM GEORGE MARQUETTE
ARLOW BURDETTE STOUT
NORMAN TAYLOR

CONTENTS

Studies of West Indian plants—IX . . . NATHANIEL LORD BRITTON 1
A quantitative, volumetric and dynamic study of the vegetation of the Pinus Taeda belt of Virginia and the Carolinas . . . ROLAND M. HARPER 39
INDEX TO AMERICAN BOTANICAL LITERATURE 99

PUBLISHED FOR THE CLUB
THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President

HERBERT M. RICHARDS, Sc.D.

Vice-Presidents

JOHN HENDLEY BARNHART, A.M., M.D.
C. STUART GAGER, PH.D.

Secretary and Treasurer

BERNARD O. DODGE, PH.D.
Dept. of Botany, Columbia University
New York City

MEETINGS

Meetings twice each month from October to May inclusive: the second Tuesday at 8:00 P.M., at the American Museum of Natural History; the last Wednesday, at 3:30 P.M., in the Museum Building of the New York Botanical Garden.

PUBLICATIONS

All subscriptions and other business communications relating to the publications of the Club should be addressed to the Treasurer, Dr. Bernard O. Dodge, Dept. of Botany, Columbia University, New York City.

Bulletin. Monthly, established 1870. Price, $4.00 a year; single numbers 40 cents. Of former volumes, only 24–43 can be supplied separately; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Manuscripts intended for publication in the BULLETIN should be addressed to the Editor, Osborn Botanical Laboratory, Yale University, New Haven, Connecticut.

Torreya. Monthly, established 1901. Price, $1.00 a year. Manuscripts intended for publication in TORREYA should be addressed to Norman Taylor, Editor, Brooklyn Botanic Garden, Brooklyn, N. Y.

Memoirs. Occasional, established 1889. (See last pages of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles of New York City, 1888. Price, $1.00

Reprints. Contributors of articles accepted for publication in the BULLETIN should order reprints, if desired, when they return galley proof to the editor. 25 copies of reprints without cover may be had gratis. If cover is wanted, or if more than 25 copies are wanted, they may be ordered through the editor at the following rates from The New Era Printing Co., Lancaster, Pa., the contributor paying for all his reprints.

	2pp	4pp	8pp	12pp	16pp	20pp
25 copies	$ .75	$1.05	$1.30	$1.80	$2.20	$2.50
50 copies	.90	1.20	1.70	2.20	2.50	2.85
100 copies	1.15	1.55	1.95	2.55	2.90	3.20
200 copies	1.70	2.35	2.90	3.75	4.35	4.70

Covers: 25 for 75 cents, additional covers 1 cent each.

Plates for reprints, 40 cents each per 100.

CONTENTS

BRITTON, NATHANIEL LORD. Studies of West Indian plants—IX - - 1
HARPER, ROLAND M. A quantitative, volumetric and dynamic study of the Pinus Taeda belt of Virginia and the Carolinas - - - - - 39
RYDBERG, PER AXEL. Notes on Rosaceae—XI - - - - - - 65
BUTLER, O. On the cause of alternate bearing in the apple (plates 1–3) - 85
REED, E. L. Meadow vegetation in the montane region of northern Colorado - - - - - - - - - - - - - - - 97
GATES, R. R. A revision of the genus Polygonatum in North America (plates 4–6) - - - - - - - - - - - - - - 117
STEVENS, NEIL E. Some factors influencing the prevalence of Endothia gyrosa - - - - - - - - - - - - - - - 127
MACCAUGHEY, VAUGHAN. An annotated list of the forest trees of the Hawaiian Archipelago - - - - - - - - - - - 145
BERRY, EDWARD W. Contributions to the Mesozoic flora of the Atlantic coastal plain, XII—Arkansas (plate 7) - - - - - - - 167
EVANS, ALEXANDER W. Notes on the genus Herberta, with a revision of the species known from Europe, Canada and the United States (plate 8) - - - - - - - - - - - - - - - 191
ROCK, JOSEPH W. Notes on Hawaiian Lobelioideae, with descriptions of new species and varieties (plates 9–16) - - - - - - - 229
POVAH, ALFRED H. W. A critical study of certain species of Mucor (plates 17–20) - - - - - - - - - - - - - - 241, 287
HARRIS, J. ARTHUR, GORTNER, ROSS AIKEN, and LAWRENCE, JOHN V. The relationship between the osmotic concentration of leaf sap and height of leaf insertion in trees - - - - - - - - - - 267
RIDDLE, LINCOLN W. Some noteworthy lichens from Jamaica (plate 21) 321
BERRY, EDWARD W. A middle Eocene Goniopteris (plate 22) - - - - 331
PENNELL, FRANCIS W. Notes on plants of the southern United States—III 337
BICKNELL, EUGENE P. The ferns and flowering plants of Nantucket—XVIII - - - - - - - - - - - - - - - - 369
HOOKER, HENRY D., JR. Mechanics of movement in Drosera rotundifolia 389
SMITH, CHARLES PIPER. Studies in the genus Lupinus—I. A new species of the subgenus Platycarpos - - - - - - - - - - 405
STANDLEY, PAUL CARPENTER. The Chenopodiaceae of the North American Flora - - - - - - - - - - - - - - - 411
RYDBERG, P. A. Phytogeographical notes on the Rocky Mountain Region —VII. Formations in the Subalpine Zone - - - - - - 431
GOURLEY, J. H. Fruit bud formation—a criticism - - - - - - 455
GLEASON, HENRY ALLAN. The structure and development of the plant association - - - - - - - - - - - - - - - 463
WEATHERWAX, PAUL. The development of the spikelets of Zea Mays (plate 23) - - - - - - - - - - - - - - - 483

322832

ARTHUR, J. C. Relationship of the genus Kuehneola - - - - 501
MACCAUGHEY, VAUGHAN. The guavas of the Hawaiian Islands - - 513
EVANS, ALEXANDER W. A new Lejeunea from Bermuda and the West Indies (plate 24) - - - - - - - - - - - - 525
BROWN, MABEL MARY. The development of the embryo-sac and of the embryo in Phaseolus vulgaris (plates 25, 26) - - - - - - 535
ROCK, JOSEPH F. Hawaiian trees—a criticism - - - - - 545
SHEAR, C. L., and STEVENS, NEIL E. The botanical work of Ezra Michener - - - - - - - - - - - - - - - 547

INDEX TO AMERICAN BOTANICAL LITERATURE, 59, 111, 159, 223, 261, 315, 363, 407, 459, 497, 529, 559

Index to volume 44 - - - - - - - - - - - - - 565

Dates of Publication

No. 1, for January.	Pages 1–64.	Issued February 12, 1917.
No. 2, for February.	65–116.	February 27, 1917.
No. 3, for March.	117–166.	March 27, 1917.
No. 4, for April.	167–228.	April 16, 1917.
No. 5, for May.	229–266.	May 22, 1917.
No. 6, for June.	267–320.	June 13, 1917.
No. 7, for July.	321–368.	July 14, 1917.
No. 8, for August.	369–410.	August 10, 1917.
No. 9, for September.	411–462.	September 15, 1917.
No. 10, for October.	463–500.	October 1, 1917.
No. 11, for November.	501–534.	November 20, 1917.
No. 12, for December.	534–579.	December 24, 1917.

Errata

Page 152, line 8, for *sandwicense* read *sandwicensis*.
Page 190, line 1, for 4 read 7.
Page 323, line 14 from bottom, for *megaspermum* read *megasperma*.
Page 440, line 9, for *plebeia* read *plebeja*.
Page 442, line 2, for *plebeia* read *plebeja*.
Page 452, line 14 from bottom, for *Brunnonianum* read *Brunnoniana*.
Page 525, line 1, for **Lejunea** read **Lejeunea.**

Vol. 44 No. 1

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JANUARY, 1917.

Studies of West Indian plants—IX

NATHANIEL LORD BRITTON

52. CLEOME PROCUMBENS JACQ. AND ITS RELATIVES

The small, simple-leaved Cleomes of the West Indies, form an interesting and peculiar group of the genus, very different in habit and aspect from the large, typical, compound-leaved ones. Seven species appear to be represented.

Annuals or biennials.	
Pedicels filiform.	
Leaves linear-oblong; pod subterete.	1. *C. Sloanei.*
Leaves filiform; pod compressed.	2. *C. guianensis.*
Pedicels very short; leaves very narrowly linear.	3. *C. stenophylla.*
Perennials with woody roots.	
Pod acute or acuminate; leaves linear to oblong, acute or acuminate.	
Leaves acuminate; pedicels half as long as the pods.	4. *C. procumbens.*
Leaves acute; pedicels as long as the pods or longer.	
Petals about 4 mm. long; leaves oblong to oblong-lanceolate.	5. *C. Wrightii.*
Petals 8–10 mm. long; leaves narrowly linear.	6. *C. macrorhiza.*
Pod obtuse; leaves ovate or elliptic, obtuse or rounded.	7. *C. obtusa.*

1. CLEOME SLOANEI Urban, Symb. Ant. 5: 347. 1907

Grassy and sandy places, at low elevations, southern side of Jamaica.

This species is referred by Fawcett and Rendle, as previously by other authors, to *C. procumbens* Jacq., which is, apparently, confined to Hispaniola.

[The BULLETIN for December (43: 601–676) was issued January 10, 1917.]

2. CLEOME GUIANENSIS Aubl. Pl. Guian. **2**: 675. 1775

Sandy pine lands, Pinar del Rio, Cuba; northern South America.

3. CLEOME STENOPHYLLA Klotzsch; Urban, Symb. Ant. **4**: 251. 1905

Plains at low elevations, southern and southwestern Porto Rico; St. Bart's; Bonaire; hillsides, Curaçao; Guiana.

4. CLEOME PROCUMBENS Jacq. Stirp. Am. 189. *pl. 120.* 1763

Hispaniola. Erroneously recorded from Cuba, and, apparently also erroneously referred to Jamaica, as Jacquin's figure of the type would seem to represent a well-marked species, not collected since its original discovery.

5. CLEOME WRIGHTII Urban, Symb. Ant. **5**: 346. 1907

Sandy soil, Pinar del Rio and Isle of Pines, Cuba.

6. CLEOME MACRORHIZA Wright; Sauvalle, Anales Acad. Habana **5**: 199. 1868

Pine-lands, Pinar del Rio, Cuba.

7. **Cleome obtusa** sp. nov.

Perennial by a slender woody root, glabrous; stems numerous, prostrate, simple or few-branched, slender, 5–15 cm. long. Leaves ovate or elliptic, 4–6 mm. long, rounded or obtuse at the apex, rounded at the base, the midvein prominent, the lateral venation obscure, the petioles 1–2 mm. long; peduncles slender or filiform, 4–8 mm. long; sepals obtuse, 2–2.5 mm. long; petals yellow, oblong or oblong-obovate, obtuse or acutish, 3–4 mm. long; stamens about two-thirds as long as the petals; filaments filiform; style about 1 mm. long; capsule elliptic, elliptic-obovate or oblong, compressed, 3–6 mm. long, 2–2.5 mm. wide, obtuse at the apex, somewhat narrowed at the base, few–several-seeded.

Dry and rocky soil in palm-barrens and savannas, Camaguey and Santa Clara, and in sand on Cayo Guayaba, Cuba. Type from savannas near Camaguey (*Britton & Cowell 13165*). Hitherto included in *C. Wrightii* Urban.

53. CHAMAECRISTA MOENCH IN THE WEST INDIES

Type species: *Chamaecrista nictitans* (L.) Moench.

A. Sepals rigid, scarious, many-nerved (*Diphyllae*). 1. *C. diphylla.*

B. Sepals membranous, scarcely nerved.

a. Prostrate herbs, the flowers on filiform peduncles.

Leaflets only 1 pair, obovate; stipules cordate (*Rotundifoliae*). 2. *C. rotundifolia.*

Leaflets 3–7 pairs, oblong to obovate; stipules lanceolate (*Pilosae*).

Stems pilose. 3. *C. pilosa.*

Stems appressed-pubescent. 4. *C. serpens.*

b. Erect, ascending or rarely prostrate herbs or shrubs.

1. Midvein of the leaflet central or excentric, not marginal.

* Shrubs, with coriaceous or subcoriaceous leaves.

† Leaflets many, 20–50 pairs, linear; stipules large; stem flexuous (*Flexuosae*). 5. *C. flexuosa.*

†† Leaflets fewer, 2–12 pairs, oblong or obovate; stipules small; stem not flexuous (*Lineatae*).

‡ Foliage densely pubescent. 6. *C. grammica.*

‡‡ Foliage glabrous or puberulent.

§ Leaflets dull.

Leaflets obovate or oblanceolate.

Leaflets 2 or 3 pairs, 5 mm. long or less. 7. *C. obcordata.*

Leaflets 3–11 pairs, 7–15 mm. long.

Gland sessile. 8. *C. lineata.*

Gland stalked. 9. *C. granulata.*

Leaflets oblong.

Leaflets acute, cuspidate. 10. *C. pinetorum.*

Leaflets rounded and mucronulate at apex. 11. *C. jamaicensis.*

§§ Leaflets shining.

Leaflets oblong, or the upper obovate, 1.5 cm. long or less, strongly callous-margined.

Leaflets glabrous; gland large, nearly sessile. 12. *C. portoricensis.*

Leaflets ciliate; gland small, stalked. 13. *C. Tuerckheimii.*

Leaflets elliptic to ovate to obovate, 1.5–3 cm. long, not callous-margined.

Leaflets elliptic, acute. 14. *C. caribaea.*

Leaflets ovate to obovate, obtuse, retuse, or mucronate.

Leaflets 1–3 pairs, obovate, mostly retuse. 15. *C. inaguensis.*

Leaflets 4–9 pairs, ovate to ovate-oblong, mostly obtuse. 16. *C. lucayana.*

** Herbs or shrubs, with membranous leaves (*Glandulosae*).

† Flowers large, 2–4 cm. broad.

Leaflets villous or pubescent beneath.

Glands elongated, petiolar and also often between the leaflets; midvein of leaflets nearly central, the lateral veins many. 17. *C. glandulosa.*

Glands short, sessile, petiolar only; midvein of leaflets excentric, the lateral veins few. 18. *C. Dussii.*

Leaflets glabrous beneath.

Leaflets oblong to linear; gland stipitate. 19. *C. Swartzii.*

Leaflets obovate or oblong; gland sessile or stout-stipitate. 20. *C. polyadena.*

†† Flowers small, seldom over 1 cm. broad.

‡ Petiolar glands sessile, or very short-stalked.

Prostrate; leaflets 4–6 pairs. 21. *C. pygmaea.*

Erect or ascending; leaflets 8 pairs or more.

Plant densely hirsute all over. 22. *C. patellaria.*

Plants glabrate or more or less villous.

Pod black-banded and black-margined. 23. *C. fasciata.*

Pod not black-banded.

Leaflets 10–15 mm. long, the midvein little excentric. 24. *C. aeschinomene.*

Leaflets 5–8 mm. long, the midvein very excentric.

Petals 6 mm. long; plant sparingly short-pubescent. 25. *C. savannarum.*

Petals 3 mm. long; plant villous. 26. *C. micrantha.*

‡‡ Petiolar glands distinctly stalked.

Pod 3.5–4 mm. broad; pubescence widely spreading. 27. *C. riparia.*

Pod 3 mm. broad or less.

Petiolar glands often 2; leaflets oblong; plant glabrous, or pubescent only above. 28. *C. mirabilis.*

Petiolar gland 1; leaflets linear or linear-oblong; plant pubescent or villous. 29. *C. Chamaecrista.*

2. Midvein of the leaflet approximate to its upper margin (*Strigillosae*).

Petiolar gland small, subsessile.

Leaves sparingly pubescent. 30. *C. strigillosa.*

Leaves densely pilose. 31. *C. adenosperma.*

Petiolar gland stalked.	
Pod glabrous or nearly so.	32. *C. pedicellaris.*
Pod short-pilose.	33. *C. Buchii.*

1. CHAMAECRISTA DIPHYLLA (L.) Greene, Pittonia 4: 28. 1899

Cassia diphylla L. Sp. Pl. 376. 1753.

TYPE LOCALITY: "In India."

DISTRIBUTION: Provinces of Santa Clara, Pinar del Rio and on Isle of Pines, Cuba; Hispaniola; Porto Rico; recorded by Grisebach from St. Kitts and St. Vincent; continental tropical America.

2. CHAMAECRISTA ROTUNDIFOLIA (Pers.) Greene, Pittonia 4: 31. 1899

Cassia rotundifolia Pers. Syn. 1: 456. 1805.

Cassia bifoliata DC.; Collad. Cass. 120. 1816.

TYPE LOCALITY: South America.

DISTRIBUTION: Provinces of Santa Clara and Pinar del Rio and on Isle of Pines, Cuba; Jamaica; continental tropical America.

ILLUSTRATION: Collad. Cass. *pl. 9.*

3. CHAMAECRISTA PILOSA (L.) Greene, Pittonia 4: 28. 1899

Cassia pilosa L. Syst. Ed. 10, 1017. 1759.

Cassia Milleri Collad. Cass. 132. 1816.

TYPE LOCALITY: Jamaica (Sp. Pl. Ed. 2, 540).

DISTRIBUTION: Province of Pinar del Rio and Isle of Pines, Cuba; Jamaica; northern South America.

4. CHAMAECRISTA SERPENS (L.) Greene, Pittonia 4: 29. 1899.

Cassia serpens L. Syst. Ed. 10, 1018. 1759.

TYPE LOCALITY: Jamaica (Sp. Pl. Ed. 2, 541).

DISTRIBUTION: Provinces of Havana and Pinar del Rio, Cuba; Jamaica; northern South America.

5. CHAMAECRISTA FLEXUOSA (L.) Greene, Pittonia 4: 27. 1899

Cassia flexuosa L. Sp. Pl. 379. 1753.

Chamaecrista amplistipulata Rose, Contr. Nat. Herb. 12: 267. 1909.

TYPE LOCALITY: Brazil.

DISTRIBUTION: Pinar del Rio and Isle of Pines, Cuba; continental tropical America.

ILLUSTRATION: Breyn, *pl. 23*.

6. CHAMAECRISTA GRAMMICA (Spreng.) Pollard, Field Col. Mus. Bot. **2**: 47. 1900

Cassia grammica Spreng. Neue Entd. **3**: 55. 1822.

Cassia lineata brachyloba Griseb. Mem. Am. Acad. II. **8**: 179. 1860.

TYPE LOCALITY: Maritime regions, Cuba and Hispaniola.

DISTRIBUTION: Cuba (according to Sprengel) and collected by Wright in Oriente; Hispaniola; Porto Rico; Little St. James Island, St. Jan.

The plant of southern Florida, referred to this species by Chapman and by Small, is distinct, according to the studies of Dr. Pennell.

7. **Chamaecrista obcordata** (Sw.).

Cassia obcordata Sw.; Wikstr. Vetensk. Acad. Handl. **1825**: 429. 1826.

TYPE LOCALITY: St. Bart's.

DISTRIBUTION: St. Bart's; I refer, with doubt, Dr. Boldinghs' No. 5288B from St. Martin to this species, which he recorded as *Cassia polyadena* DC. (Fl. Nederl. West Ind. 211); the St. Martin plant is more nearly related to *C. lineata* than to *C. polyadena*. Bentham indicates the same affinity for the plant of St. Bart's (Trans. Linn. Soc. **27**: 572). No modern collections have been made on St. Bart's; it lies close to St. Martin.

8. CHAMAECRISTA LINEATA (Sw.) Greene, Pittonia **4**: 31. 1899

Cassia lineata Sw. Prodr. 66. 1788.

Cassia cuneata Griseb. Cat. Pl. Cub. 80. 1866. Not *C. cuneata* DC.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica; Cuban provinces of Oriente, Camaguey and Santa Clara, and Isle of Pines; Hispaniola; Bahamas. Specimens from the south coast of Santa Clara, Cuba, have puberulent foliage.

9. CHAMAECRISTA GRANULATA (Urban) Britton, Ann. Missouri Bot. Gard. **2**: 41. 1915

Cassia portoricensis granulata Urban, Symb. Ant. **1**: 318. 1899.
Chamaecrista portoricensis granulata Cook & Collins, Contr. Nat. Herb. **8**: 113. 1903.

TYPE LOCALITY: Near Salinas de Cabo Rojo, Porto Rico.
DISTRIBUTION: Southwestern Porto Rico; Mona.

10. **Chamaecrista pinetorum** sp. nov.

Shrubby, 4 dm. high, or higher, the branches slender, densely appressed-pubescent with brownish hairs. Stipules linear-lanceolate, striate, long-acuminate, 4–6 mm. long; leaves 3–5 cm. long, the rachis appressed-pubescent; leaflets 9 pairs or fewer, subcoriaceous, linear to linear-oblong, 10–15 mm. long, 2–4 mm. wide, glabrous on both sides, dull, acute and cuspidate at the apex, obliquely rounded at the base, closely pinnately veined, the prominent midvein nearly central, the petiolar gland slender-stalked; peduncles filiform, appressed-pubescent, 2-bracted, about 3 cm. long; sepals lanceolate, acuminate, 10–12 mm. long; petals obovate, somewhat shorter than the sepals or as long; ovary appressed-pubescent.

Pine woods, near Constanza, Santo Domingo, at 1,200 m. alt. (*Tuerckheim 2887*).

11. CHAMAECRISTA JAMAICENSIS Britton, Bull. Torrey Club **42**: 515. 1915

TYPE LOCALITY: South slope of Long Mountain, Jamaica.
DISTRIBUTION: Southern side of Jamaica.

12. CHAMAECRISTA PORTORICENSIS (Urban) Cook & Collins, Contr. Nat. Herb. **8**: 113. 1903

Cassia portoricensis Urban, Symb. Ant. **1**: 317. 1899.
Cassia portoricensis callosa Urban, Symb. Ant. **1**: 317. 1899.
Chamaecrista portoricensis callosa Cook & Collins, Contr. Nat. Herb. **8**: 113. 1903.

TYPE LOCALITY: Near Guayanilla, Porto Rico.
DISTRIBUTION: Southern and western Porto Rico.

13. **Chamaecrista Tuerckheimii** sp. nov.

Shrubby, with a deep woody root; stems slender, villous-pubescent, 8–10 cm. long. Stipules obliquely ovate-lanceolate, acuminate, striate, 2–3 mm. long; leaves 2–2.5 cm. long, the rachis villous-pubescent; leaflets 6 or 7 pairs, linear-oblong, to oblong-oblanceolate, 6–8 mm. long, about 2 mm. wide, ciliate, shining, rounded or subtruncate and mucronulate at the apex, obliquely rounded at the base, pinnately veined with the prominent midvein somewhat excentric, the petiolar gland short-stalked; peduncles slender, villous, about 2 cm. long; sepals lanceolate, acuminate, villous, 7–8 mm. long; petals obovate, about twice as long as the sepals; legume linear, narrowed at both ends, nearly glabrous, 1.8 cm. long.

Near Maniel de Ocoa, Santo Domingo, in fields, 300 m. alt. (*Tuerckheim 3680*).

14. **Chamaecrista caribaea** (Northrop)

Cassia caribaea Northrop, Mem. Torrey Club **12**: 39. 1902.

TYPE LOCALITY: Fresh Creek, Andros, Bahamas.

DISTRIBUTION: Andros, New Providence and Cat Island, Bahamas.

ILLUSTRATION: Northrop, *loc. cit. pl. 6.*

15. **Chamaecrista inaguensis** comb. nov.

Cassia inaguensis Britton, Bull. N. Y. Bot. Gard. **3**: 443. 1905.

TYPE LOCALITY: Inagua, Bahamas.

DISTRIBUTION: Inagua, South Caicos, Grand Turk, and Ambergris Cay, Bahamas.

16. **Chamaecrista lucayana** comb. nov.

Cassia lucayana Britton, Bull. N. Y. Bot. Gard. **4**: 138. 1906.

TYPE LOCALITY: Cay north of Wide Opening, Exuma Chain, Bahamas.

DISTRIBUTION: Great Bahama, Cat Island, Conception, Rum Cay, and Exuma Chain, Bahamas.

17. CHAMAECRISTA GLANDULOSA (L.) Greene, Pittonia **4**: 28. 1899

Cassia glandulosa L. Syst. Ed. 10, 1017. 1759.
Cassia virgata Sw. Prodr. 66. 1788.

?Cassia stricta Schrank, Hort. Monac. 1: *pl. 34.* 1819.
Chamaecrista virgata Greene, Pittonia 4: 31. 1899.

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Jamaica.

ILLUSTRATIONS: Bot. Mag. *pl. 3435;* Schrank, *loc. cit.*

Linnaeus included, in his citations of synonyms of this species, several others, but his description of it, together with his having received a Jamaica specimen from the collection of Patrick Browne, prior to his publication, as I am informed by Dr. B. Daydon Jackson, Secretary of the Linnaean Society of London, show that the name is to be restricted to the Jamaica plant. Subsequent authors have confused it with species from other islands and from continental tropical America. The identity of *Cassia virgata* Sw. was established for me by Mr. William Fawcett at the British Museum of Natural History. *Cassia stricta* Schrank, from the illustration and the Jamaica habitat, appears referable here, but Schrank's description of the plant is not altogether conclusive; he says the root is annual.

18. **Chamaecrista Dussii** sp. nov.

Perennial, villous-pubescent, erect, simple, 5–9 dm. high, somewhat woody. Stipules narrowly lanceolate, strongly striate, 10–12 mm. long; leaves 5–7 cm. long; petiolar gland close to the lowest leaflets, scutelliform, sessile, slightly concave, nearly 1 mm. in diameter; leaflets about 17 pairs, linear, pubescent on both sides, 10–18 mm. long, 2–3 mm. wide, obtuse, mucronate, inequilateral, the midvein excentric, the lateral veins few and distant; peduncles 4–6 mm. long; sepals lanceolate, acuminate, pubescent, about 7 mm. long; petals obovate, 8–10 mm. long; pod linear, slightly curved, villous-pubescent, obliquely short-tipped, 3 cm. long, 5 mm. wide.

Guadeloupe and Martinique. Type from Trou-Vaillant, Parnasse, Martinique (*Père Duss 1121*).

19. **Chamaecrista Swartzii** (Wickstr.)

Cassia Swartzii Wikstr. Vetensk. Acad. Handl. **1825**: 430. 1826.
Chamaecrista complexa Pollard, Field Col. Mus. Bot. 2: 47. 1900.

TYPE LOCALITY: St. Bart's.

DISTRIBUTION: Porto Rico; Vieques; Culebra; St. Thomas; St. Jan; Tortola; St. Croix; Saba; St. Bart's; St. Kitt's; Dominica; Guadeloupe; Grenada.

The species has been much confused with the Jamaican *C. glandulosa*.

20. **Chamaecrista polyadena** (DC.)

Cassia polyadena DC. Mém. Soc. Hist. Nat. Gen. **2**: 132. 1824.

TYPE LOCALITY: Guadeloupe.

DISTRIBUTION: Guadaloupe; Dominica; Martinique; Barbadoes.

My identification of this species is based on my examination of the type, some years ago, in the Candollean herbarium at Geneva, Switzerland. Notwithstanding the usually sessile petiolar gland and the relatively broader leaflets, I am not confident that this species is distinct from the preceding one.

21. **Chamaecrista pygmaea** (DC.)

Cassia pygmaea DC. Mém. Soc. Hist. Nat. Gen. **2**: 131. 1824.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Hispaniola.

Referred by Bentham to *Cassia procumbens* L., which is a synonym of *C. nictitans* L. of continental North America, as previously indicated by me (Bull. Torrey Club **43**: 463).

22. CHAMAECRISTA PATELLARIA (DC.) Greene, Pittonia **4**: 32. 1899

Cassia patellaria DC.; Collad. Cass. 125. 1816.

TYPE LOCALITY: Cayenne.

DISTRIBUTION: Jamaica; all provinces of Cuba and on the Isle of Pines; continental tropical America.

ILLUSTRATION: Collad. Cass. *pl. 16*.

23. CHAMAECRISTA FASCIATA Britton, Bull. Torrey Club **37**: 352. 1910

TYPE LOCALITY: Between Bath and Cuna-Cuna Gap, Jamaica.

DISTRIBUTION: Jamaica; Cuban provinces of Oriente, Camaguey, Santa Clara and Havana.

24. CHAMAECRISTA AESCHINOMENE (DC.) Greene, Pittonia **4**: 32. 1899

Cassia aeschinomene DC.; Collad. Cass. 127. 1816.

Chamaecrista Millspaughii Pollard, Field Col. Mus. Bot. **2**: 47. 1900.

Cassia mimosoides aeschynomene Benth. Trans. Linn. Soc. **27**: 579. 1871.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Jamaica; all provinces of Cuba; Hispaniola; Porto Rico.

ILLUSTRATION: Collad. Cass. *pl. 17*.

25. CHAMAECRISTA SAVANNARUM Britton, Bull. Torrey Club **43**: 463. 1916

TYPE LOCALITY: Near Siguanea, Isle of Pines, Cuba.

DISTRIBUTION: Savannas and pine-lands, Pinar del Rio and Isle of Pines, Cuba.

26. CHAMAECRISTA MICRANTHA Britton, Bull. Torrey Club **43**: 463. 1916

TYPE LOCALITY: Near San Pedro, Isle of Pines, Cuba.

DISTRIBUTION: Pine-lands and savannas, Pinar del Rio and Isle of Pines, Cuba. Referred by Grisebach to *Cassia pygmaea* DC.

27. **Chamaecrista riparia** (HBK.)

Cassia riparia HBK. Nov. Gen. **6**: 369. 1824.

TYPE LOCALITY: Banks of the Magdelena River near Mompox.

DISTRIBUTION: Jamaica; province of Havana, Cuba; Grand Cayman; Andros, New Providence and Eleuthera, Bahamas; northern South America and recorded from Central America.

The plant of the Bahamas was referred by me with some doubt (Bull. N. Y. Bot. Gard. **3**: 443) to *Cassia aspera* Muhl., which it closely resembles, except in the petiolar gland. Cuban and Jamaican specimens differ from the Bahaman in having the gland somewhat longer-stalked.

I have not been able to study an authentic specimen of *C. riparia*. Bentham's record of it as West Indian was based upon a plant collected in Cuba by Liebmann, preserved in the Kew herbarium.

28. CHAMAECRISTA MIRABILIS Pollard, Proc. Biol. Soc. Wash. **15**: 19. 1902

Cassia mirabilis Urban, Symb. Ant. **4**: 276. 1905.

TYPE LOCALITY: Rio Piedras, Porto Rico.

DISTRIBUTION: Northern coastal plain of Porto Rico.

29. **Chamaecrista Chamaecrista** (L.)

Cassia Chamaecrista L. Sp. Pl. 379. 1753.
Cassia diffusa DC. Mém. Soc. Hist. Nat. Gen. **2**: 130. 1824.
Cassia smaragdina Macf. Fl. Jam. **1**: 347. 1837.
Chamaecrista diffusa Britton, Ann. Missouri Bot. Gard. **2**: 41. 1915.

TYPE LOCALITY: Curaçao.

DISTRIBUTION: Bahamas; Jamaica; Cuba; ? Hispaniola; Porto Rico; St. Jan; St. Croix; St. Kitts; Guadeloupe; Grenada; Curaçao; Margarita.

ILLUSTRATIONS: Breyn, *pl. 24;* Schrank, Hort. Monac. *pl. 33.*

The species has been much confused with the annual *C. nictitans* of eastern continental North America.

The recognition of the plant of Curaçao as typical *Cassia Chamaecrista* brings *C. diffusa* into its synonymy.

30. **Chamaecrista strigillosa** (Benth.)

Cassia strigillosa Benth. Trans. Linn. Soc. **27**: 581. 1871.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Province of Oriente, Cuba; Santo Domingo (according to Bentham). Referred by Grisebach to *Cassia serpens* L.

31. **Chamaecrista adenosperma** (Urban)

Cassia adenosperma Urban, Symb. Ant. **5**: 362. 1908.

TYPE LOCALITY: Sierra del Palo Quemado, Santo Domingo.

DISTRIBUTION: Known only from the type locality, and, to me, only from the description.

32. **Chamaecrista pedicellaris** (DC.)

Cassia pedicellaris DC. Prodr. **2**: 504. 1825.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Hispaniola.

33. **Chamaecrista Buchii** (Urban)

Cassia Buchii Urban, Symb. Ant. **5**: 361. 1908.

TYPE LOCALITY: Near Gonaives, Haiti.

DISTRIBUTION: Known only from the type locality and, to me, only from the description.

54. THE GENUS LEUCOCROTON GRISEB.

A Cuban genus, of which four species have been described. *L. Wrightii* Griseb. is the type species.

A. Leaves pinnately veined.
  Leaves chartaceous.
    Pistillate inflorescence 1-flowered at the summit; staminate flowers racemose. 1. *L. Wrightii*.
    Pistillate flowers racemose, the staminate glomerate-spicate. 2. *L. flavicans*.
  Leaves coriaceous, linear-oblong or linear.
    Leaves densely whitish-scurfy beneath.
      Leaves strongly revolute-margined, not reticulate-veined beneath, coarsely reticulate-veined above. 3. *L. revolutus*.
      Leaves slightly revolute-margined, strongly reticulate-veined beneath, finely reticulate-veined above. 4. *L. saxicola*.
    Leaves glabrous on both sides.
      Leaves mostly rounded and mucronulate at the apex, dull, 6–10 mm. wide. 5. *L. angustifolius*.
      Leaves emarginate, shining, 3–5 mm. wide. 6. *L. linearifolius*.
B. Leaves palmately 5-veined. 7. *L. virens*.

1. LEUCOCROTON WRIGHTII Griseb. Abh. Kön. Gesell. Wiss. Götting. **9**: 21. 1860

Woodlands and banks of streams, Oriente; Pinar del Rio.

2. LEUCOCROTON FLAVICANS Muell. Arg. in DC. Prodr. **15**^{2}: 757. 1866

L. flavicans latifolius Muell. Arg. *loc. cit.* 1866.
L. flavicans angustifolius Muell. Arg. *loc. cit.* 1866.

Serpentine hillsides, Matanzas, Havana. The locality of C. Wright's no. 1994 is not recorded.

3. LEUCOCROTON REVOLUTUS Wright; Sauvalle, Anales Acad. Habana **7**: 154. 1870

Known only from the type locality between La Mulata and La Palme, Pinar del Rio.

4. **Leucocroton saxicola** sp. nov.

A shrub, 1–3.3 m. high, much branched, the twigs short and stout. Leaves coriaceous or subcoriaceous, narrowly oblong or oblanceolate, 3–11 cm. long, 2 cm. wide or less, rounded or emarginate and apiculate at the apex, narrowed at the base, finely

reticulate-veined, glabrous, and with impressed midvein above, strongly reticulate-veined, minutely scurfy and with prominent midvein beneath, the petioles 3–6 mm. long; staminate flowers racemose-spicate in the upper axils, the inflorescence 2–3 cm. long; bracts lanceolate, acute, about 1.5 mm. long; pedicels 1–2 mm. long; buds subglobose, lepidote, 1 mm. in diameter.

Rocky banks and hillsides, mountains of northern Oriente. Type collected at Arroyo del Medio, above the falls, 450–550 m. alt. (*Shafer 3466*).

Similar to *L. revolutus*, but the venation of the leaves is quite different. In *L. revolutus* only the pistillate inflorescence is known; in *L. saxicola* only the staminate.

5. **Leucocroton angustifolius** sp. nov.

A much-branched, spreading shrub, about 6 dm. high, the twigs bearing distant leaf-scars. Leaves scattered, coriaceous, glabrous, linear or linear-oblong, 5–10 cm. long, 13 mm. wide or less, revolute-margined, rounded and mucronulate or emarginate at the apex, narrowed at the base, the midvein impressed above, prominent beneath, the primary lateral veins numerous, diverging at nearly right angles from the midvein, both surfaces reticulate-veined, the petioles 4–6 mm. long; pistillate flowers solitary at the ends of clustered, terminal, slender, scaly, bracted peduncles 2–3 cm. long; bracts lanceolate, numerous, acute, ascending, 1.5 mm. long; calyx-segments lanceolate, similar to the bracts; ovary depressed-globose, obtusely 3-lobed, lepidote; styles stout, recurved.

Rio Guayabo, above the falls, Oriente, 450–550 m. alt. (*Shafer 3626*).

6. **Leucocroton** (?) **linearifolius** sp. nov.

A much-branched shrub about 6 dm. high, the twigs short, stiff, covered by leaf-scars. Leaves densely clustered at the ends of the twigs, coriaceous, glabrous, linear, 3–6 cm. long, 3–5 mm. wide, shining on both sides, emarginate at the apex, gradually narrowed to the base, short-petioled, the midvein impressed above, prominent beneath, the lateral veins very numerous and close together, prominent on both surfaces, diverging nearly at right angles to the midvein, simple, or forked; staminate flowers few, in short, solitary slender-peduncled racemes shorter than the leaves, the pedicels filiform, 2 mm. long, the bractlets linear-lanceolate; bud of the staminate flower globose, 1 mm. in diameter.

Rocky bank of river at Camp La Barga, Oriente, 450 m. alt. (*Shafer 4144*).

7. LEUCOCROTON VIRENS Griseb. Nachr. Gesell. Wiss. Götting. 1865: 175

Mountain woodlands, Oriente. The foliage of this species is very different from that of the others.

55. PASSIFLORA IN CUBA

Type species: *Passiflora incarnata* L.

A. Flowers subtended by 3 large foliaceous bracts [GRANADILLA].
  Bracts united below the middle; leaves ovate, entire, membranous. 1. *P. maliformis.*
  Bracts distinct to the base.
    Branches sharply 4-angled; leaves ovate, entire, membranous. 2. *P. quadrangularis.*
    Branches not 4-angled.
      Leaves entire, subcoriaceous, glabrous. 3. *P. laurifolia.*
      Leaves lobed or parted.
        Leaves pedately parted, membranous, pubescent, the segments serrate. 4. *P. pedata.*
        Leaves obtusely 3-lobed, glabrous, the lobes entire. 5. *P. pallens.*
B. Flowers subtended by small or pectinate-pinnatifid bracts, or bractless.
  1. Flower-tube cylindric or cylindric-campanulate; corona not plicate [MURUCUJA].
    Leaves entire, ovate to elliptic. 6. *P. cuprea.*
    Leaves lobed or subtruncate.
      Leaves 2-lobed or subtruncate.
        Leaves membranous, not reticulate-veined, deeply 2-lobed, the lobes acute. 7. *P. nipensis.*
        Leaves coriaceous, reticulate-veined, the lobes obtuse or rounded, or apex subtruncate. 8. *P. cubensis.*
      Leaves 3-lobed at the apex. 9. *P. Shaferi.*
  2. Flower-tube short or none; corona longitudinally plicate [PLECTROSTEMMA].
A. Petals none.
  Leaves 3-divided, the segments stalked, 3-cleft. 10. *P. Berteriana.*
  Leaves lobed or entire. 11. *P. pallida.*
B. Petals present.
  a. Flowers subtended by pinnntisect bracts.
    Leaves membranous, flaccid. 12. *P. foetida.*
    Leaves chartaceous.
      Plant densely velvety-pubescent. 13. *P. gossypifolia.*
      Plants glabrous, usually with some stalked glands. 14. *P. pseudociliata.*
  b. Bracts small, not pectinate-pinnatifid.
    * Peduncles elongated, 1-flowered, longer than the leaves. 15. *P. penduliflora.*

** Peduncles much shorter than the leaves.
Leaves 2-lobed, mostly broader than long.
Flowers solitary, slender-peduncled, 3–4 cm. broad; fruit 3–5 cm. in diameter. 16. *P. rubra.*
Flowers clustered in the axils, 1.5–2 cm. broad, very short-peduncled, the pedicels slender; fruit about 8 mm. in diameter. 17. *P. sexflora.*
Leaves entire or bluntly 3-lobed, longer than broad.
Leaves oblong or oblong-lanceolate, entire, rounded at the base. 18. *P. multiflora.*
Leaves broadly ovate, obtusely 3-lobed, mostly cordate at the base. 19. *P. holosericea.*
C. Published species not grouped.
Leaves ovate to elliptic, dentate. 20. *P. dasyadenia.*
D. Known only from foliage. Leaves deeply 3-lobed, the lobes dentate. 21. A plant of the Isle of Pines.

1. PASSIFLORA MALIFORMIS L. Sp. Pl. 956. 1753

TYPE LOCALITY: Near Port de Paix, Santo Domingo.

DISTRIBUTION: Oriente, collected by Wright:—Hispaniola to Barbadoes; Jamaica; South America. Perhaps not indigenous in Cuba.

2. PASSIFLORA QUADRANGULARIS L. Syst. Ed. 10, 1248. 1759

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Uncommon at Santiago de las Vegas (*Van Hermann 616*):—Native of Nicaragua; widely cultivated in tropical America, and locally spontaneous.

3. PASSIFLORA LAURIFOLIA L. Sp. Pl. 956. 1753

TYPE LOCALITY: Surinam.

DISTRIBUTION: Thicket, upper valley of the Rio Navas, Oriente (*Shafer 4411*):—native from St. Thomas and St. Jan to Trinidad and South America. Spontaneous after cultivation in Hispaniola and Jamaica.

4. PASSIFLORA PEDATA L. Sp. Pl. 960. 1753

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Woods and thickets, Santa Clara, Pinar del Rio:—Hispaniola; northern South America.

5. PASSIFLORA PALLENS Poepp.; Masters in Mart. Fl. Bras. 13[1]: 567. *pl. 128, f. 4.* 1872

TYPE LOCALITY: Cuba.

DISTRIBUTION: Thickets, Havana, Pinar del Rio:—Florida; Venezuela.

Recorded by Grisebach and by Sauvalle as *P. stipulata* Aubl.

6. PASSIFLORA CUPREA L. Sp. Pl. 955. 1753

TYPE LOCALITY: New Providence, Bahamas.

DISTRIBUTION: Near Baracoa, Oriente; cays of northern Camaguey:—Bahamas.

7. **Passiflora nipensis** sp. nov.

Glabrous, glandless, slender, 8 dm. long or longer. Leaves cuneate, 2-lobed to the middle or beyond, 1.5–3 cm. long, rather strongly 3-nerved, the nerves impressed above, prominent beneath, excurrent, the secondary venation sparse and slender, the lobes lanceolate, acute, the slender petioles 2.5–5 mm. long; tendrils filiform, 2–4 cm. long; peduncles solitary or geminate in the axils, 10–14 mm. long; fruit globose, dark blue, about 1.5 cm. in diameter; seeds oblong, transversely ridged, about 3 mm. long.

Open dry situations in pine lands, Sierra Nipe near Woodfred, Oriente, 500–650 m. alt. (*Shafer 3554*).

8. PASSIFLORA CUBENSIS Urban, Symb. Ant. 3: 326. 1902

Passiflora coriacea A. Rich. in Sagra, Hist. Cub. 10: 288. 1845. Not Juss.

TYPE LOCALITY: Cuba.

DISTRIBUTION: Serpentine barrens, savannas and coastal thickets, Oriente, Camaguey, Santa Clara, Havana. Endemic.

Referred by Grisebach to *P. murucuja* L. and to *P. oblongata* Sw. The species is variable in leaf-form.

9. **Passiflora Shaferi** sp. nov.

A glabrous vine, about 2 m. long. Leaves thin, elliptic-obovate, 4–5 cm. long, bluntly and shallowly 3-lobed at the apex, rounded or obtuse at the base, strongly 3-nerved, each nerve extending to a lobe and scarcely, if at all, excurrent, with 2 weaker short basal nerves, both surfaces reticulate-veined, the upper

surface somewhat shining, the lower dull, the glandless petioles 4–7 mm. long; peduncles mostly 2 together in the axils, 1–2 cm. long; bractlets subulate, 1.5–2 mm. long; flowers about 3 cm. long, red, the tube cylindric, 1–1.5 cm. long; fruit subglobose, about 1 cm. in diameter.

Between Navas and Camp Buena Vista, Oriente, at 650 m. alt. (*Shafer 4466*).

10. PASSIFLORA BERTERIANA Balb.; DC. Prodr. 3: 325. 1828

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Recorded by Grisebach as collected in Cuba by Wright:—Santo Domingo.

11. PASSIFLORA PALLIDA L. Sp. Pl. 955. 1753

Passiflora minima L. Sp. Pl. 959. 1753.
Passiflora suberosa L. Sp. Pl. 958. 1753.
Passiflora hirsuta L. Sp. Pl. 958. 1753.
Passiflora angustifolia Sw. Prodr. 97. 1788.
Passiflora hederacea Cav. Diss. 10: 448. 1790.

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Banks, thickets and hillsides, all provinces and Isle of Pines:—Florida; Bermuda; West Indies and tropical continental America. The many races differ in leaf-form and pubescence.

12. PASSIFLORA FOETIDA L. Sp. Pl. 959. 1753

TYPE LOCALITY: Dominica.

DISTRIBUTION: Thickets and roadsides, Oriente, Havana, Pinar del Rio, Isle of Pines:—West Indies; continental tropical America; Old World tropics.

13. PASSIFLORA GOSSYPIFOLIA Desv. in Hamilt. Prodr. Pl. Ind. Occ. 48: 1825

P. foetida gossypifolia Masters in Mart. Fl. Bras. 13[1]: 582. 1872.

TYPE LOCALITY: Not cited, presumably West Indian.

DISTRIBUTION: Dry hillsides, southern Oriente:—continental tropical America.

14. **Passiflora pseudociliata** sp. nov.

? *Passiflora ciliata polyadena* Griseb. Cat. Pl. Cub. 285. 1866.

Herbaceous, glabrous, 2 m. long or less. Leaves membranous, but not flaccid, variously 3-lobed, or sometimes 5-lobed, 2–8 cm. broad, bearing few or many slender-stalked glands, or glandless, the lobes oblong, acute or obtuse, few-toothed or entire, the slender petioles 1–5 cm. long; peduncles solitary in the axils, longer than the petioles, sometimes nearly as long as the leaves; bracts pectinate-pinnatifid; flowers blue, 4–6 cm. broad; petals narrowly oblong, blunt; crown-processes filiform, much shorter than the petals; fruit inflated, bladdery, ellipsoid or subglobose, red, 3–6 cm. long, short-stipitate, longer than the bracts.

Barren hillsides and coastal thickets, Camaguey, Santa Clara, Matanzas, Havana, Pinar del Rio.

Type from rocky soil in savanna near Camaguey (*Britton & Cowell 13155*).

Referred by Grisebach to *P. ciliata* Ait., and by Combs to *P. foetida* L.

Specimens from the Sierra Nipe, Oriente, with large leaves and fruit (*Shafer 3081, 3618*) are doubtfully referred to *P. ciliata* Ait., but they do not show the bracts, which, in *P. ciliata* of Jamaica, are as long as the fruit or longer.

15. PASSIFLORA PENDULIFLORA Bert.; DC. Prodr. 3: 326. 1828

TYPE LOCALITY: Jamaica.

DISTRIBUTION: Coastal woods and thickets, Oriente, Camaguey:—Jamaica.

16. PASSIFLORA RUBRA L. Sp. Pl. 956. 1753

TYPE LOCALITY: Martinique.

DISTRIBUTION: Banks and thickets at lower and middle elevations, Oriente, Camaguey, Santa Clara, Matanzas, Havana:—West Indies; continental tropical America.

The *Passiflora pubescens* HBK., recorded as Cuban by A. Richard, is, presumably, this species.

17. PASSIFLORA SEXFLORA Juss. Ann. Mus. Paris 6: 110. *pl. 37, f. 1.* 1805

TYPE LOCALITY: Santo Domingo.

DISTRIBUTION: Thickets and hillsides, Oriente, Santa Clara:—

Florida; Jamaica; Hispaniola; Porto Rico; recorded from St. Kitts; Mexico and Central America.

18. PASSIFLORA MULTIFLORA L. Sp. Pl. 956. 1753

TYPE LOCALITY: Near Port de Paix, Santo Domingo.

DISTRIBUTION: Rocky banks and coastal thickets, Oriente, Camaguey, Santa Clara, Pinar del Rio, Isle of Pines:—Florida, Bahamas; Hispaniola to Tortola; recorded from Costa Rica.

19. PASSIFLORA HOLOSERICEA L. Sp. Pl. 958. 1753

Passiflora reticulata C. Wright; Sauvalle, Anales Acad. Habana **6**: 96. 1869.

TYPE LOCALITY: Vera Cruz [Mexico].

DISTRIBUTION: Rocky hillsides and coastal thickets, Matanzas, Pinar del Rio:—Mexico.

20. PASSIFLORA DASYADENIA Urban, Symb. Ant. **3**: 328. 1902

TYPE LOCALITY: Near El Aji [Oriente].

DISTRIBUTION: Type locality and collected also on the Sierra de Anafe, Pinar del Rio (*Wilson & Leon 11534*); flowers of both the Oriente and the Pinar del Rio plant are unknown.

21. PASSIFLORA

A high climbing, sparingly pubescent vine. Petioles slender, 2–4 cm. long, bearing 2 small glands below the middle; leaves subchartaceous, deeply 3-lobed, subtruncate at base, 10 cm. long or less, the oblong lobes 1–3 cm. wide, acute, dentate, loosely reticulate-veined.

Coastal plain, San Juan, Isle of Pines (*Britton & Wilson 15476*).

Passiflora incarnata L. of eastern continental North America is recorded by A. Richard (Sagra, Hist. Cub. **10**: 289) as having been found in Cuba, but I have no other evidence of its occurrence there.

56. RONDELETIA IN CUBA

Type species: *Rondeletia americana* L.

A. Capsule globose to globose-pyriform.

1. Inflorescence terminal or terminal and axillary.

a. Twigs strigose.

Cymes several–many-flowered; leaves elliptic to ovate-elliptic, 3–8 cm. long. 1. *R. odorata*.

Peduncles 1–3-flowered; leaves oblong, 5–20 mm. long. 2. *R. microphylla.*

b. Twigs glabrous or puberulent.

* Pedicels very slender or filiform.

† Leaves small, 1–2.5 cm. long; peduncles 1- to few-flowered.

Calyx-lobes dilated above.

Leaves ovate, rounded or subcordate at the base; calyx-lobes little dilated. 3. *R. Shaferi.*

Leaves oblong, oval or obovate, narrowed or obtuse at the base; calyx-lobes much dilated.

Wholly glabrous; petioles 1–2 mm. long. 4. *R. peduncularis.*

Petioles ciliate, 4–7 mm. long. 5. *R. pachyphylla.*

Calyx-lobes linear or subulate, not dilated.

Foliage puberulent. 6. *R. pedicellaris.*

Foliage glabrous. 7. *R. alaternoides.*

†† Leaves up to 7 cm. long; inflorescence several- to many-flowered. 8. *R. subglabra.*

** Pedicels stout, short.

† Leaves petioled.

Capsule subglobose or short-pyriform.

Corolla densely silky-pubescent. 9. *R. brachycarpa.*

Corolla glabrous or with a few scattered hairs.

Calyx-teeth deltoid, minute. 10. *R. stellata.*

Calyx-teeth ovate or oblong.

Petioles slender; capsule subglobose. 11. *R. angustata.*

Petioles stout; capsule subpyriform. 12. *R. canellaefolia.*

Capsule oblong, about twice as long as thick; leaves elongated, petioled. 13. *R. calcicola.*

†† Leaves sessile, oblong-oblanceolate; capsule short-pyriform. 14. *R. yamuriensis.*

2. Inflorescence axillary or lateral.

a. Peduncles elongated, often as long as the leaves or longer.

Leaves sessile, cordate, 5–8 cm. long. 15. *R. correifolia.*

Leaves petioled, 3–5 cm. long.

Petioles about 2 mm. long. 16. *R. Lindeniana.*

Petioles 8–12 mm. long.

Stipules triangular, obtuse; leaves obtuse or rounded at the base. 17. *R. nimanimae.*

Stipules linear-subulate, broadened below; leaves rounded at the base. 18. *R. Leoni.*

b. Peduncles short, much shorter than the leaves.

* Leaves membranous to chartaceous; inflorescence mostly few- to several-flowered, rarely 1-flowered.

† Leaves faintly reticulate-veined beneath or not reticulate-veined.
Leaves glabrous, or merely puberulent, the venation obscure. 19. *R. chamaebuxifolia.*
Leaves densely strigose-pubescent beneath, pinnately veined. 20. *R. intermixta.*
†† Leaves strongly reticulate-veined beneath.
‡ Leaves ovate to elliptic.
Leaves rounded at the apex.
Calyx-lobes triangular; leaves 4 cm. long or less, the petioles stout. 21. *R. lomensis.*
Calyx-lobes ovate-oblong; leaves 2 cm. long or less, the petioles slender. 22. *R. baracoensis.*
Leaves acute or acutish at the apex; inflorescence subcapitate.
Inflorescence subsessile. 23. *R. rigida.*
Inflorescence manifestly peduncled. 24. *R. nipensis.*
‡‡ Leaves oblong.
Calyx-lobes linear, linear-lanceolate or ovate, acute or acutish.
Leaves 1 cm. long or less. 25. *R. Rugelii.*
Leaves 1.5–6 cm. long. 26. *R. Combsii.*
Calyx-lobes broadly ovate, rounded or obtuse.
Leaves tomentulose beneath. 27. *R. camarioca.*
Leaves strigose on the veins beneath. 28. *R. insularis.*
** Leaves coriaceous, mostly small; peduncles mostly 1-flowered.
Leaves elliptic to orbicular, obtuse or rounded.
Leaves silvery-puberulent beneath. 29. *R. savannarum.*
Leaves tomentose beneath.
Leaves elliptic, 1.5–2 cm. long; calyx-lobes linear-lanceolate, acuminate. 30. *R. venosa.*
Leaves oval or orbicular, 5–15 mm. long; calyx-lobes oblong, obtuse. 31. *R. hypoleuca.*
Leaves oblong, acute or acutish.
Leaves glabrous, green both sides. 32. *R. vacciniifolia.*
Leaves white-tomentulose beneath, dark-green and glabrous above. 33. *R. bicolor.*
B. Capsule linear-oblong, 2 cm. long; inflorescence terminal. 34. *R. tinifolia.*
C. Species not grouped. 35. *R. camagueyensis.*

1. RONDELETIA ODORATA Jacq. Enum. Pl. Carib. 16. 1760

R. speciosa Lodd. Bot. Cab. 19: *pl. 1893.* 1832.

TYPE LOCALITY: Coastal thickets, Havana [Jacquin, Sel. Stirp. 59].

DISTRIBUTION: Hillsides and thickets at lower and middle elevations, Santa Clara, Matanzas, Havana, Pinar del Rio. Recorded by Richard from Oriente. Recorded from Mexico. Cultivated for ornament.

2. RONDELETIA MICROPHYLLA Griseb. Cat. Pl. Cub. 127. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: River-banks, Pinar del Rio. Endemic.

The leaves are sometimes larger than those of the type specimens, attaining a length of 3 cm.

3. RONDELETIA SHAFERI Urban & Britton; Urban, Symb. Ant. 7: 398. 1912

TYPE LOCALITY: Barren savannas near Holguin, Oriente.

DISTRIBUTION: Known only from the type locality.

Dr. Shafer's notes indicate that the plant grows along watercourses.

4. RONDELETIA PEDUNCULARIS A. Rich. in Sagra, Hist. Cub. 11: 14. 1850

TYPE LOCALITY: Vuelta de Abajo.

DISTRIBUTION: Rocky banks and beds of streams, Oriente, Pinar del Rio. Endemic.

5. RONDELETIA PACHYPHYLLA Krug & Urban; Urban, Symb. Ant. 1: 419. 1899

TYPE LOCALITY: Cuba.

DISTRIBUTION: Rocky stream-beds, mountains of northern Oriente. Endemic.

Recorded by Grisebach as *R. alaternoides* A. Rich. The inflorescence is both terminal and axillary.

6. RONDELETIA PEDICELLARIS C. Wright; Sauvalle, Anales Acad. Habana 6: 102, 121. 1869

TYPE LOCALITY: Vicinity of Trinidad.

DISTRIBUTION: Cliffs and rocky hillsides, southern Santa Clara. Endemic.

7. RONDELETIA ALATERNOIDES A. Rich. in Sagra, Hist. Cub. **11**: 13. 1850

TYPE LOCALITY: Mountains near Santiago [Oriente].

DISTRIBUTION: Known only from the type locality.

Urban states (Symb. Ant. **1**: 419) that the inflorescence of this species is terminal, not axillary as first described.

8. RONDELETIA SUBGLABRA Krug & Urban; Urban, Symb. Ant. **1**: 418. 1899

TYPE LOCALITY: Near Santiago, at 1,400 m. elevation [Oriente].

DISTRIBUTION: Mountains of Oriente. Endemic.

9. RONDELETIA BRACHYCARPA (Griseb.) C. Wright; Sauvalle, Anales Acad. Habana **6**: 122. 1869

Ferdinandea brachycarpa Griseb. Mem. Am. Acad. II. **8**: 505. 1862.

TYPE LOCALITY: Thickets near Santa Catalina [Oriente].

DISTRIBUTION: Thickets and hillsides, Oriente, Camaguey, Santa Clara, Havana, Pinar del Rio:—Hispaniola.

Referred by Combs to *R. trifolia* Jacq.

10. RONDELETIA STELLATA (Griseb.) C. Wright; Sauvalle, Anales Acad. Habana. **6**: 122. 1869

Ferdinandea stellata Griseb. Mem. Am. Acad. II. **8**: 505. 1862.

TYPE LOCALITY: Pine-lands near Monte Verde [Oriente].

DISTRIBUTION: Mountains of northern Oriente. Endemic.

11. RONDELETIA ANGUSTATA C. Wright; Sauvalle, Anales Acad. Habana **6**: 122. 1869

Ferdinandea angustata C. Wright; Griseb. Cat. Pl. Cub. 127. 1866.

TYPE LOCALITY: In bogs near Toscano.

DISTRIBUTION: Arroyos and barrens, Santa Clara, Matanzas, Pinar del Rio. Endemic.

12. **Rondeletia canellaefolia** sp. nov.

A glabrous shrub about 2.5 m. high, the twigs rather stout. Leaves coriaceous, elliptic-obovate or elliptic-oblanceolate, oppo-

site or verticellate, 10 cm. long or less, 1.5–3 cm. wide, dark green, shining above, dull beneath, obtuse or acute at the apex, cuneate at the base, the midvein prominent, the lateral veins few, distant, slender, the petioles 5–15 mm. long; inflorescence terminal and in the upper axils, few–several-flowered; peduncles 1.5–5 cm. long; pedicels short and stout; bracts triangular, minute; calyx 3–4 mm. long, its lobes foliaceous, ovate, obtuse, 1–1.5 mm. long; corolla glabrous, about 4 mm. long (immature); capsule pyriform, 1–1.5 cm. long.

Woods and on cliffs, Sierra Nipe, near Woodfred, Oriente, 450–550 m. alt. Type, *Shafer 3297*. In foliage and capsules similar to *R. stellata*, but that has minute calyx-lobes.

13. RONDELETIA CALCICOLA Britton, Bull. Torrey Club 43: 467. 1916

TYPE LOCALITY: Coe's Camp, Ensenada de Siguanea, Isle of Pines.

DISTRIBUTION: Known only from the type locality.

14. **Rondeletia yamuriensis** sp. nov.

A small tree, about 4 m. high, glabrous throughout. Leaves coriaceous, narrowly oblong-oblanceolate, 6–9 cm. long, 1–2 cm. wide, sessile, acute or obtuse at the apex, narrowed at the base, opposite or verticillate in 3's, the midvein rather prominent, the lateral veins few and slender; inflorescence terminal and also in the uppermost axils; peduncles rather slender, 6 cm. long or less; fruiting pedicels 5–10 mm. long; capsule globose-pyriform, about 1 cm. long.

Between Yamuri Arriba and Bermejal, Oriente (*Shafer 8439*).

15. RONDELETIA CORREIFOLIA Griseb. Cat. Pl. Cub. 129. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Pine-lands and savannas, Pinar del Rio and Isle of Pines. Endemic. A virgate shrub, up to 2 m. high, the large white flowers fragrant.

16. RONDELETIA LINDENIANA A. Rich. in Sagra, Hist. Cub. 11: 13. 1850

TYPE LOCALITY: Mountains near Santiago [Oriente].

DISTRIBUTION: Mountains of Oriente. Endemic. Recorded by Grisebach as *R. buxifolia* Vahl, and, doubtfully, by Sauvalle, as *R. umbellulata* Sw.

17. RONDELETIA NIMANIMAE Krug & Urban; Urban, Symb. Ant. 1: 418. 1899

TYPE LOCALITY: Near Nimanima, at 800 m. alt. [Oriente].

DISTRIBUTION: Known only from the type locality.

18. **Rondeletia Leoni** sp. nov.

A shrub or small tree up to 3 m. high, the slender young twigs, the petioles and the inflorescence appressed-pubescent with short, whitish hairs. Leaves elliptic to obovate, 3–8 cm. long, subcoriaceous, acute, short-acuminate, or some of them obtuse at the apex, narrowed or cuneate at the base, flat, or the margins somewhat revolute when old, densely pubescent with appressed hairs when young, glabrous, or sparingly pubescent on the veins beneath when old, inconspicuously reticulate-veined, the slender petioles 12 mm. long or less; stipules linear-subulate with a broadened base, pubescent, 3–4 mm. long; inflorescence axillary or lateral, 4–6 cm. long, 1–few-flowered, sometimes with a pair of small, leaf-like bracts; pedicels nearly filiform, 1–2 cm. long; bractlets linear-subulate; calyx ovoid-campanulate, densely canescent, its lobes linear or linear-spatulate, 3–4 mm. long; corolla densely white-pubescent without, its tube slender, 10–12 mm. long, cylindric, slightly expanded above, its lobes oblong-orbicular, rounded, deep purple above, 2.5–3 mm. long; capsule subglobose, 4–5 mm. in diameter.

Sancti Spiritus Mountains, Santa Clara; type from Sierra del Caballete (*Leon & Clement 6560*).

19. RONDELETIA CHAMAEBUXIFOLIA Griseb. Cat. Pl. Cub. 128. 1866

Rondeletia avenia C. Wright; Sauvalle, Anales Acad. Habana **6**: 121. 1869.

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Known only from the type locality, this not definitely recorded.

20. **Rondeletia intermixta** sp. nov.

A shrub, 1.6 m. high, the young twigs densely strigose-pubescent. Stipules triangular-ovate, pubescent, acute, persistent, spreading, about 2 mm. long; leaves oblong, chartaceous, 3–6 cm. long, acute at both ends, dark green and glabrous above, pale green and densely pubescent beneath, the midvein rather promi-

nent, the lateral veins few, the slender petioles 8–15 mm. long; inflorescence axillary, short-peduncled, few–several-flowered, densely pubescent; bractlets ovate, acute, about 1 mm. long; calyx-teeth ovate, short; capsule globose, about 3 mm. in diameter, pubescent.

Gran Piedra, Oriente, at about 1,500 m. alt. (*Shafer 9039*). Apparently the same as a part of *C. Wright 1266*, recorded by Griesbach as *Rondeletia Poitaei* Griseb., but that name (Griseb. Fl. Br. W. I. 328) is a synonym of *Stevensia buxifolia* Poit., a plant known only from Hispaniola.

21. RONDELETIA LOMENSIS Urban, Symb. Ant. 7: 394. 1912

TYPE LOCALITY: Dry serpentine hill, Loma Santa Teresa, near El Yunque, Oriente.

DISTRIBUTION: Known only from the type locality.

Dr. Shafer's notes describe this as a shrub about 2.6 m. high with white flowers; the corollas are not shown in the specimens.

22. **Rondeletia baracoensis** sp. nov.

Twigs slender, densely whitish-pubescent when young. Stipules triangular-ovate, acute, pubescent, about 2 mm. long; leaves chartaceous, elliptic, 2 cm. long or less, rounded or obtuse at the apex, narrowed or obtuse at the base, glabrous and obscurely veined above, whitish-tomentulose and reticulate-veined beneath with the primary venation prominent, the petioles 3–5 mm. long; peduncles opposite, rather stout, 1–3-flowered, 3–13 mm. long; bractlets lanceolate, pubescent, somewhat shorter than the calyx; calyx 3 mm. long, its lobes ovate or ovate-oblong, obtuse, one half as long as the tube; corolla-bud densely white-pubescent.

Vicinity of Baracoa (*Pollard, Palmer & Palmer 245*).

23. RONDELETIA RIGIDA Griseb. Mem. Am. Acad. II. 8: 505. 1862

TYPE LOCALITY: La Madelina [Oriente].

DISTRIBUTION: Known only from the type locality.

24. RONDELETIA NIPENSIS Urban, Symb. Ant. 7: 393. 1912.

TYPE LOCALITY: Sierra Nipe, near Woodfred, Oriente, in pine-lands, 500–650 m. alt.

DISTRIBUTION: Pine-lands and deciduous woods of the Sierra Nipe, Oriente.

Dr. Shafer's notes show this to be a shrub about 1.3 m. high, with white flowers.

25. RONDELETIA RUGELII Urban, Symb. Ant. **7**: 397. 1912

Rondeletia Poitaei microphylla Griseb. Cat. Pl. Cub. 128. 1866.

TYPE LOCALITY: near Matanzas.

DISTRIBUTION: Known definitely only from the type locality.

Rugel's label indicates that this is a shrub growing in rocks. The species is related to the following one. Grisebach considered the plant to be the same as *R. Berteriana* A. Rich. (not DC.), which was collected at La Cabana, Havana. *R. Berteriana* DC., of Hispaniola, is clearly different.

26. RONDELETIA COMBSII Greenm. Trans. Acad. St. Louis **7**: 427, *pl. 34*. 1897

TYPE LOCALITY: Calicita [Santa Clara].

DISTRIBUTION: Hillsides, cliffs and rocky shores, Santa Clara; Havana. Endemic.

Plants with identical foliage have calyx-lobes ovate or lanceolate; Dr. Greenman's original description indicates that they may even be linear. A fruiting specimen from Bahia Honda, Pinar del Rio (*Wilson 9409*), is doubtfully referred to this species.

27. RONDELETIA CAMARIOCA C. Wright; Sauvalle, Anales. Acad. Habana **6**: 102. 1869

TYPE LOCALITY: Savannas of Camarioca [Matanzas].

DISTRIBUTION: Serpentine barrens and savannas, in dry soil, Camaguey; Santa Clara; Matanzas. Endemic.

28. **Rondeletia insularis** sp. nov.

A much-branched shrub, about 2 m. high, the twigs densely appressed-pubescent. Stipules triangular-ovate, connate, pubescent, persistent, 2–3 mm. long; leaves gray-green, oblong or oblong-obovate, chartaceous, 3 cm. long or less, 7–10 mm. wide, glabrous and very obscurely veined above, delicately reticulate-veined and strigillose beneath, the stout petioles about 1.5 mm. long; peduncles solitary in the axils, stout, about as long as the petioles, 1-flowered, pubescent; bractlets ovate, acute, 1 mm. long; capsule globose, densely puberulent, 4–5 mm. in diameter; calyx-lobes ovate-oblong, obtuse, 1 mm. long.

Vicinity of Pueblo Romano, Cayo Romano, Camaguey (*Shafer 2444*).

29. **Rondeletia savannarum** sp. nov.

A shrub, about 2 m. high, the twigs densely appressed-pubescent. Stipules triangular, acute, finely pubescent, 1–1.5 mm. long; leaves oblong to oblong-elliptic, 2 cm. long or less, 6–10 mm. wide, coriaceous, obtuse at the apex, narrowed at the base, glabrous, dark green and obscurely veined above, silvery-puberulent beneath with the few veins rather prominent, the petioles about 1.5 mm. long; flowers solitary in the axils; peduncles stout, 2–3 mm. long; calyx-teeth linear with the base broadened, 3 mm. long, about as long as the calyx-tube; corolla-bud densely pubescent; capsule globose, densely puberulent, 4 mm. in diameter.

Barren savannas, southeast of Holguin, Oriente (*Shafer 1230*, type; *2933*).

30. RONDELETIA VENOSA Griseb. Cat. Pl. Cub. 128. 1866

TYPE LOCALITY: Near San Marcos, Bahia Honda [Pinar del Rio].

DISTRIBUTION: Known only from the type locality.

31. RONDELETIA HYPOLEUCA Griseb. Cat. Pl. Cub. 128. 1866

TYPE LOCALITY: Eastern Cuba, near Baracoa.

DISTRIBUTION: Rocky situations, Oriente. Endemic.

A plant with orbicular leaves 5–7 mm. long, collected in a rocky thicket between Camp La Barga and Camp San Benito at about 1,000 m. alt. (*Shafer 4121*), is referred to this species with hesitation.

32. **Rondeletia vacciniifolia** sp. nov.

A much-branched shrub 0.3–1.3 m. high, the young twigs densely appressed-pubescent. Stipules triangular, acute, connate, pubescent, 1.5–2 mm. long; leaves oblong, coriaceous, 6–12 mm. long, acute at both ends, or the apex obtuse and mucronate, glabrous on both sides or sparingly pubescent on the midvein beneath, the lateral venation obscure, the stout, pubescent petioles 1.5–3 mm. long; flowers solitary in the upper axils, the stout, pubescent peduncles about as long as the petioles; bractlets triangular-ovate, acute; calyx-teeth linear, 2–3 mm. long; capsule globose, pubescent, 5 mm. in diameter, reddish.

Rocky situations, mountains of northern Oriente. Type from rocky bank of river, vicinity of Camp San Benito at 900 m. alt. (*Shafer 4090*).

33. **Rondeletia bicolor** sp. nov.

A shrub about 1.7 m. high, the twigs ascending, slender, densely short-pubescent when young. Stipules triangular-lanceolate, rather abruptly attenuate from a broad base, short-pubescent, about 3 mm. long; leaves oblong or oblong-oblanceolate, coriaceous, 2–3 cm. long, acute or some of them obtuse at the apex, narrowed at the base, dark green, glabrous and very obscurely veined above, white tomentulose and prominently veined beneath, the pubescent petioles 2–4 mm. long; peduncles axillary, pubescent, in fruit about 3 mm. long; fruits solitary, globose, pubescent, about 3 mm. in diameter.

Loma de Ponciano, Sancti Spiritus Mountains, Santa Clara (*Leon and Clement 6717*).

34. **Rondeletia** (?) **tinifolia** Griseb. Cat. Pl. Cub. 129. 1866

TYPE LOCALITY: Western Cuba.

DISTRIBUTION: Sancti Spiritus Mountains, Santa Clara; pinelands and arroyos, Pinar del Rio. Endemic.

35. **Rondeletia** (?) **camagueyensis** sp. nov.

A shrub about 3 m. high, the young shoots densely appressed-pubescent. Stipules triangular, acute, about 3 mm. long; leaves ovate or elliptic-ovate, 3–4 cm. long, 3 cm. wide or less, membranous, acute at the apex, narrowed or obtuse at the base, sparingly short-pubescent and indistinctly veined above, loosely strigose-pubescent, especially on the prominent veins beneath, the stout, pubescent petioles 2–3 mm. long; capsule subglobose, 4–6 mm. in diameter.

Arroyo, savanna near Camaguey (*Britton & Cowell 13206*).

Imperfect material only was collected at the time of our visit to the locality in April, 1912.

OTHER SPECIES ATTRIBUTED TO CUBA

Rondeletia microdon DC. Prodr. 4: 408. 1830

Havana, collected by Ossa, according to De Candolle. Described as a glabrous species, with oval-oblong, short-petioled

leaves acute at both ends, bipartite, persistent, obtuse stipules; corymbose peduncled flowers, the calyx truncate, with five short teeth. The genus of this plant was questioned by A. Richard (in Sagra, Hist. Cub. 11: 13), and I do not know any species which answers to the description.

Rondeletia americana L. Sp. Pl. 172. 1753

This, the type of the genus, is also recorded by De Candolle as found at Havana by Ossa, and Grisebach (Fl. Br. W. I. 327) mentions it as Cuban. I know the plant only from St. Vincent and Jamaica.

Rondeletia laevigata Ait. Hort. Kew. ed. 2, 1: 366. 1810

De Candolle mentions this also as found at Havana, but no species answering to the description is known to me from Cuba; Grisebach (Fl. Br. W. I. 328) indicates that it is from the island of Trinidad.

Rondeletia leptacantha DC. Prodr. 4: 410. 1830

Collected by Ossa, near Havana, according to De Candolle. Described as a plant with opposite spines, broadly oval, subacute leaves, the twigs and leaves subpilose when young, the slender peduncle as long as the leaves or longer, three- to five-flowered at the apex. No species of *Rondeletia* known to me answers the description. Grisebach (Cat. Pl. Cub. 133) refers the plant to *Chomelia fasciculata* Sw. [*Anisomeris fasciculata* (Sw.) Schum.], but this disposal of it is not satisfactory.

57. THREE ERIOCAULONS FROM THE ISLE OF PINES

Eriocaulon arenicola Britton & Small, sp. nov.

Plants 4–26 cm. tall, the scapes solitary or usually several together; leaves ascending or spreading, 1–8 cm. long, linear-attenuate, convex beneath, slightly concave above, glabrous; scapes slender, mostly 6-angled, slightly spirally twisted, each subtended by an obliquely opened sheath which is shorter than the leaves; heads dense, at first depressed-globose, later subglobose or ovoid-globose, becoming about 5 mm. in diameter, pubescent, whitish-gray; bracts of the involucre cuneate to obovate, the outer ones about 1.5 mm. long; flowers numerous,

crowded; bracts very broadly cuneate, fully 1.5 mm. long, short-hairy at and near the apex; sepals of the staminate flowers concave, cuneate to obovate, about 1.5 mm. long, exceeding the corolla, pubescent at the apex; corolla-lobes minute, ovate to oblong-ovate, obtuse; anthers about 0.25 mm. long; sepals of the pistillate flowers about 1.5 mm. long, boat-like, keeled, pubescent near the top; petals oblong to oblong-spatulate, fully 1 mm. long; capsule reniform-didymous, fully 0.5 mm. wide: seeds oval, barely 0.5 mm. long.

White sand, vicinity of Los Indios (*Britton & Wilson 14179*).

This plant is related to *Eriocaulon sigmoideum* C. Wright. It differs from it in the larger size, the more compact heads, the more copiously pale-pubescent and longer bracts, the smaller staminate flowers, and the sepals of the pistillate flowers which are wider below the middle, instead of at the top.

Eriocaulon fusiforme Britton & Small, sp. nov.

Plants 3–6.5 cm. tall, the scapes tufted, usually densely so; leaves ascending or recurved, subulate-lanceolate, 1–2.5 cm. long, thinnish, concave, glabrous; scapes relatively slender, spirally twisted, prominently 5-angled, each subtended by an obliquely opened sheath which is shorter than the longer leaves; heads dense, fusiform, becoming 7–8.5 mm. long, acute, glabrous, brownish; bracts of the involucre ovate to oblong, obtuse, chartaceous, 2–3 mm. long; flowers numerous; bracts rhombic-ovate or rhombic-cuneate, mostly 2 mm. long, acute or short-acuminate, scarious, glabrous, or obscurely fine-pubescent; sepals of the staminate flowers spatulate to oblong-spatulate, about 1 mm. long, sometimes laciniate at the apex, about equalling the corolla or exceeding it; corolla-lobes ovate; anthers about 0.15 mm. long; sepals of the pistillate flowers about 1.5 mm. long, boat-shaped, strongly keeled and crested above the middle, acuminate; petals linear-elliptic to linear-spatulate, 1.5–2 mm. long; capsule suborbicular or orbicular-ovoid, about 0.5 mm. wide: seeds narrowly oval, about 0.5 mm. long.

Pinelands, Siguanea (*Britton & Wilson 14951*).

This differs from all described Cuban species of *Eriocaulon*. Its short stiff scapes and fusiform glabrous or nearly glabrous heads are particularly diagnostic.

Eriocaulon ovoideum Britton & Small, sp. nov.

Plants 6–11 cm. tall, the scapes tufted, usually densely so; leaves erect or ascending, narrowly linear-lanceolate to linear-

attenuate, 1–3 cm. long, concave, thinnish, glabrous; scapes stoutish, spirally-twisted, sharply 5-angled, each subtended by an obliquely opened sheath which is as long as the leaves or shorter; heads very dense, ovoid or globose-ovoid, becoming 6–8 mm. long, obtuse, tan-colored; bracts of the involucre ovate to oblong, 1.5–3 mm. long, obtuse, glabrous, chartaceous; flowers numerous; bracts subreniform, mostly wider than long, broadly rounded at the apex, scarious, minutely pubescent; sepals of the staminate flowers obovate to cuneate, concave, fully 1 mm. long, erose at the apex, mostly exceeding the corolla; anthers ovoid, about 0.1 mm. long; sepals of the pistillate flowers boat-shaped, fully 1 mm. long, keel-winged and crested on the back, abruptly pointed: petals spatulate, about 1.5 mm. long, often erose at the apex; capsule reniform, about 1 mm. wide; seeds broadly oval, fully 0.5 mm. long.

White sand, vicinity of Los Indios (*Britton & Wilson 14220*).

Related to *Eriocaulon fusiforme*, differing in stouter habit, the short and broad heads, and in the broad and rounded bracts.

58. UNDESCRIBED CUBAN SPECIES

Dupatya montana sp. nov.

Stem simple, elongate, stout, densely leafy. Leaves broadly linear, 8–14 cm. long, 6–15 mm. broad at the base, narrowed to the acute apex, rigid, glabrous, striate-nerved; peduncles erect, 15–30 cm. high, often numerous, axillary, loosely pubescent with long, soft, white hairs, or glabrous; sheaths shorter than the leaves, acuminate; heads solitary on the peduncles, hemispheric, 7–8 mm. broad; outer involucral bracts ovate, the inner ones broadly oval to orbicular, rigid, acute, glabrous; receptacle pilose, the bracts membranaceous, obovate-cuneate, 1.8–2 mm. long, 0.6–0.8 mm. broad, with a tuft of short hairs on the back at the apex; staminate flowers dimerous; sepals spatulate-obovate, about 1.9 mm. long, concave, ciliate at the apex; pistillate flowers dimerous; sepals elliptic, concave; stigmas 2; ovary globose-ovate.

Collected on compact red iron ore along trail from Rio Yamaniguey to Camp Toa, Oriente, at 400 m. alt. (*J. A. Shafer 4473*, type); also collected along trail from Camp La Barga to Camp San Benito (*Shafer 4104*) and at Camp La Gloria, south of Sierra Moa (*Shafer 8045, 8251*).

Apparently closely related to **Dupatya pungens** (Griseb.) Britton (*Paepalanthus pungens* Griseb.), another Cuban species.

Pilea Cowellii sp. nov.

Glabrous, perennial, monoecious, about 4 dm. tall; stem becoming more or less grooved and compressed in drying, clothed with numerous, small, elliptic raphides; leaves elliptic to ovate, or the uppermost oblong-obovate, 1–3 cm. long, 0.7–1.1 cm. broad, acute or obtuse at the apex, rounded and more or less cordate at the base, 3-nerved, green and lustrous above, paler beneath, with prominent, scattered, elevated callosites when fresh which become depressed in drying, entire; raphides of the upper surface linear, those of the lower surface punctiform; petioles 1–2 mm. long; inflorescence axillary, 1–2 cm. long, equalling or shorter than the leaves; staminate and pistillate flowers intermixed; staminate flowers: pedicels 0.5 mm. long, perianth glabrous, 1 mm. long, the lobes triangular-ovate; stamens 4; pistillate flowers short-pedicelled or subsessile.

Type collected on cliffs, Ensenada de Mora, Oriente (*Britton, Cowell & Shafer 12977*).

Ichthyomethia havanensis Britton & Wilson, sp. nov.

A shrub 2 m. tall, with finely pubescent twigs; leaves odd-pinnate, 1–1.4 dm. long, the petioles, rachis and petiolules velvety-ferruginous when young; leaflets 9–13, elliptic to somewhat elliptic-obovate, 2.3–4.5 cm. long, 1.3–1.7 cm. broad, acute to rounded and often apiculate at the apex, rounded at base, short-petioluled, densely clothed with short, appressed, silky hairs when young, in age glabrous or nearly so above, finely pubescent and reticulate-veined beneath; calyx campanulate, pubescent with short, appressed brownish hairs; pods broadly 4-winged, puberulent with appressed hairs, 2–3.5 cm. long, 2–2.8 cm. broad, stipitate, the margin more or less undulate; seeds oblong, 5 mm. long, 2.5–3 mm. broad.

Related to *I. piscipula* (L.) A. S. Hitchc., but differing in the much smaller and more coarsely reticulate leaflets, and smaller fruit.

Thickets not far from Cojimar, Province of Havana (*Brother Leon & Father M. Roca 6194*, type); also collected on a hill west of Chorrera, Province of Havana (*Brother Leon 5192*).

Castelaria calcicola Britton & Small, sp. nov.

A much-branched shrub up to 2.5 m. tall, with stout thorns which are branched when well developed, the twigs closely fine-

pubescent; leaf-blades obovate, varying to oval or ovate, mostly 1.5–4 cm. long, rounded or retuse and mucronulate at the apex, entire, slightly revolute and reticulate in age, bright green above, paler beneath, somewhat shining, minutely pubescent, especially on the midrib and veins beneath, short-petioled; flowers several in each cluster, short-pedicelled, the pedicels densely pubescent; sepals triangular-ovate, about 1 mm. long, green, acutish, copiously pubescent; petals ovate or oval, concave, cymbiform, 3.5–4 mm. long, red, sparingly pubescent on the back; filaments subulate, nearly 2 mm. long, villous-tomentose; anthers slightly longer than the filaments, oblong, or nearly so; drupes flat, fully 1.5 cm. long, nearly as wide, about 6 mm. thick, bright-red, the flesh thin, with a fibrous-reticulate network which is impressed into the putamen.

Limestone hills, vicinity of Sumidero, Pinar del Rio (*Shafer 13434*).

This shrub is related to *Castelaria jacquinifolia*. It differs from that species in the pubescent leaves, the triangular-ovate sepals, the pubescent petals, and the narrower and longer anthers.

Stenostomum obovatum sp. nov.

A straggling tree, the slender twigs glabrous. Leaves coriaceous, obovate, 6 cm. long or less, rounded at the apex, narrowed at the base, revolute-margined, faintly shining, the midvein impressed above, prominent beneath, the lateral venation slender and obscure, the stout petioles 3–5 mm. long; inflorescence terminal; fruits in pairs, sessile, oblong, black, fleshy, 10–12 mm. long, 5–7 mm. thick.

Camp La Gloria, south of Sierra Moa, Oriente (*Shafer 8169*).

Stenostomum aristatum sp. nov.

A rough-barked tree about 6 m. high, with widely spreading branches, the slender young twigs resinous. Stipules broadly ovate, obtuse, 3 mm. long, caducous; leaves elliptic or ovate-elliptic, coriaceous, 2.5 cm. long or less, acute and aristate at the apex, mostly obtuse at the base, shining and strongly reticulate-veined on both surfaces, especially above, the margins slightly revolute, the petioles 1–2 mm. long; peduncles solitary in the uppermost axils, about one-half as long as the leaves, 1- to 3-flowered at the apex; flowers fragrant; calyx narrowly campanulate, 5 mm. long, 5-lobed, the lobes oblong or oblong-obovate, 1.5–2 mm. long, rounded; corolla white, its tube narrowly cylindric, about 2 cm. long, 1 mm. thick, its limb spreading, 5-lobed, about 1 cm.

broad, the lobes rounded; stamens 5; anthers linear, 2 mm. long; ovary 6-celled.

Rocky hill, savanna near Camaguey (*Britton & Cowell 13241*).

59. NOTES ON VARIOUS SPECIES

Evolvulus siliceus Britton & Wilson, nom. nov.

Evolvulus arenicola Britton & Wilson, Bull. Torrey Club **43**: 466. 1916. Not *E. arenicola* Johnston, 1905.

PERSICARIA HIRSUTA (Walt.) Small

Marsh near Ferry River, Jamaica (*Britton 394*). Hitherto unrecorded from Jamaica.

PHENAX SONNERATII (Poir.) Wedd.

Gravelly soil, Jamaica (*Alex. E. Wright 193*). Hitherto unrecorded from Jamaica.

PHYLLANTHUS NUMMULARIAEFOLIUS Poir.

Shady places, Hope Grounds, Jamaica (*Harris 12123, 12157, 12208*). Hitherto unrecorded from Jamaica.

VERONICA TOURNEFORTII Gmelin

Waste and shaded grounds, near Mandeville (*Crawford 683*) and near Cinchona, Jamaica (*Harris 12417*).

JACQUINIA KEYENSIS Mez.

Northern coast of Camaguey and Matanzas provinces, Cuba (*Shafer 689, 2593, 2712; Britton & Wilson 14043*); Little Goat Island, Jamaica (*Britton 1852*); Albion Mountain, Jamaica (*Harris 11678, 12199*). Heretofore recorded from the Bahamas and Florida.

CYRILLA BREVIFOLIA N. E. Brown

Mountains of northern Oriente, Cuba (*Shafer 4060, 4054, 4109, 4140, 4181, 8032*). Apparently identical with the plant of Mt. Roraima, British Guiana (Trans. Linn. Soc. II. **6**: 22. *pl. 1, f. 7–16*).

STEMODIA PARVIFLORA Ait.

Rio Piedras, Porto Rico (*Stevenson 2178*). Hitherto unrecorded from Porto Rico.

DITTA MYRICOIDES Griseb.

Sierra de Naguabo, Porto Rico (*Shafer 3603*). Hitherto unrecorded from Porto Rico.

SIDA EGGERSII E. G. Baker

Island of Culebra, Porto Rico, 1906 (*Britton & Wheeler 178*). Hitherto known only from Tortola, where Dr. Shafer made a second collection of it in 1913. A tree, 6–8 m. high, very different from typical species of *Sida*.

OSSAEA DOMINGENSIS Cogn.

Alto de la Bandera, Porto Rico (*F. L. Stevens 8717*). Hitherto known only from Santo Domingo.

LESCAILLEA EQUISETIFORMIS Griseb.

This monotypic genus of Compositae was rediscovered on the southern slope of Cajalbana in the province of Pinar del Rio, Cuba, by Brothers Leon and Charles on April 6, 1915. The genus has hitherto been imperfectly known, as it was represented in this country only by a fragment at the Gray Herbarium, collected by Charles Wright in western Cuba. *Lascaillea* is a woody vine related to *Porophyllum*. The leaves are reduced to small scales, the plant resembling certain species of *Ephedra* much more closely than it does any *Equisetum*.

A quantitative, volumetric and dynamic study of the vegetation of the Pinus Taeda belt of Virginia and the Carolinas

ROLAND M. HARPER

(WITH ONE TEXT FIGURE)

Introduction. The study of the vegetation of a given region may conveniently be divided into four stages. First, the various species of plants are collected, described (if necessary), and classified taxonomically, and their local distribution determined. Second, they are classified "ecologically," by habitat, associations and adaptations, and the environmental factors analyzed. Third, their relative abundance is determined, in the region as a whole or in each habitat separately, and estimates made of the percentages of evergreens, vines, parasites, plants belonging to certain families, etc. Fourth, the total bulk or weight of vegetation per unit area may be measured, together with the amount of new growth made in an average year, and the amount of water and other substances taken from the soil at the same time.

Although this is perhaps the usual and most convenient order, and also corresponds pretty well with the historical development of the science of plant sociology,* it is by no means a fixed order. Any one of the stages may be omitted, and the fourth, which though rather difficult is simple enough, could very well precede the first. And of course it is not to be assumed that the foregoing outline covers everything that needs to be known about vegetation. For example, it takes no account of generalizations about geographical distributions, times of flowering, colors of flowers, pollination and dissemination, studies of endemism and bibliographic history, and speculations about geological history and succession, all of which have contributed many pages to the botanical literature. Comparisons with similar or neighboring regions are always appropriate, too.

The region under consideration offers little attraction to the botanist who does not go beyond the first stage, and "cannot see

* See Torreya 16: 138. June, 1916.

the woods for the trees." As seems to be the case wherever *Pinus Taeda* (and the same might be said of several other pines) is the prevailing tree,* nearly all the plants are of common and widely distributed species, which have been described long ago. In the second stage, very little has been done in this region, largely because of inherent difficulties which will be explained below under the head of vegetation. This paper is chiefly concerned with the third stage, determining the relative abundance of the species in the region as a whole, which is done by means of notes accumulated during about seventy-five hours of field work. For the fourth stage, volumetric and dynamic studies, very few accurate data are available as yet for this or any other part of the world, but some rough estimates are attempted, to illustrate a method which should be followed in all future critical studies of vegetation. For it cannot be disputed that the annual growth of vegetation, and particularly the amount of food taken from the soil in a given time, is closely correlated with enviromental factors, and should be a better indication of soil fertility than any static studies of vegetation, whether qualitative or quantitative.

Location and boundaries of the region. The *Pinus Taeda* belt proper of the Atlantic coastal plain, as mapped by the writer a few years ago† (in FIG. 1 the same map is reproduced), is regarded as bounded on the north by the James an Appomattox Rivers. From Petersburg, Va., to the vicinity of Rocky Mount, N. C., it borders the fall-line, which there (as all the way across Virginia) runs just about north and south. Thence to near Fairfax, S. C., it passes northwestward into a belt of low red hills, a continuation of the Eocene red hills of Georgia, Alabama and Mississippi. From Fairfax to near Charleston it is bounded on the south by the pine-barrens with *Pinus Elliottii;* thence to near the mouth of the Santee River it is separated from the coast by a narrow coast strip, with marshes, islands, and a good deal of silty

* See Torreya 7: 44–45. 1907; 9: 217. 1909. This applies to habitats, though, rather than to regions. For example, *Pinus Taeda* is the commonest tree in the Apalachicola bluff region of Middle Florida (see 6th Ann. Rep. Fla. Geol. Surv. 212–215, 353, 355), where many rare plants grow; but the pine is mostly near the top of the bluffs and the rare plants lower down.

† Bull. Torrey Club 37: 407, 592. 1910–11.

soil. From Horry County, S. C., to Onslow County, N. C., it passes gradually southeastward into the Wilmington or Cape Fear pine-barrens, with a much larger proportion of *Pinus palustris* and less *P. Taeda*. From Carteret County, N. C., to Nansemond

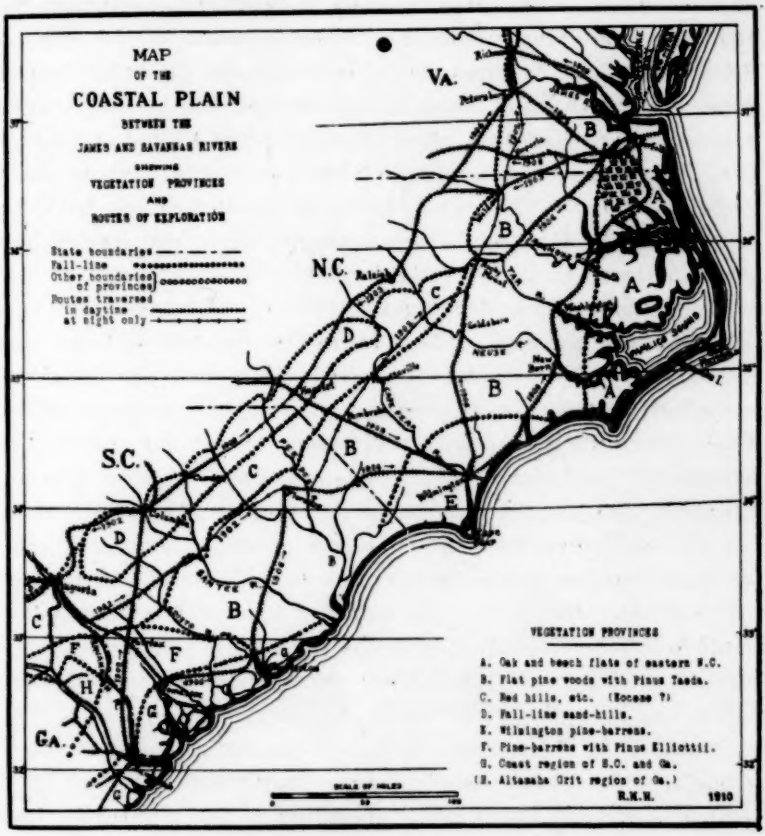

FIG. 1.

County, Va., the Nansemond escarpment, parallel to the Virginia fall-line,* separates it from the region of oak and beech flats with more silty soil, in which Dismal Swamp is situated. In South Carolina the belt under consideration corresponds approximately with the "upper pine belt" of Hammond and other nineteenth century geographers.

* See Hobbs, Rep. 8th Int. Geog. Cong. (1905), line III on map opposite p. 196.

In the present paper the red hill belt lying just southeast of the fall-line sand-hills in the Carolinas is combined with the flatter and more sandy *Pinus Taeda* belt, being connected with it apparently by imperceptible gradations, and not differing much in vegetation. The total area involved is about 28,000 square miles. The most important literature on the region was summarized by the writer in 1907.* Since then there have been published several more government soil surveys, a report on the geology of the coastal plain of North Carolina,† Coker's Plant Life of Hartsville, S. C.,‡ and Ashe's monograph on loblolly or North Carolina pine.§ C. S. Chapman's "A working plan for forest lands in Berkeley County, South Carolina,"‖ which was cited in my 1907 paper, will be referred to more specifically below.

Topography and hydrography. The altitude ranges from sea-level to about 300 feet. The topography is gently undulating in the red hills and nearly flat elsewhere, with few railroad cuts deep enough to obstruct the view of the traveler on a passenger train. There are bluffs near some of the rivers, but all the streams are bordered at least on one side by swamps, whose width is approximately proportional to the size of the stream. The rivers which rise in the Piedmont region are muddy, but the smaller streams which are confined to the coastal plain are not, except in prolonged wet weather. In the flat areas are many very shallow depressions, which will be referred to again under the head of vegetation. The ground-water is nearly everywhere close enough to the surface to be reached by well-sweeps and suction pumps.

Soils. The average soil might be described as a grayish sandy loam, varying toward red clay in the higher portions, and purer sand near some of the rivers. According to the government soil surveys hitherto published for this region (none for Virginia, about nine for North Carolina and eight for South Carolina), the eight commonest types of soil in the North Carolina portion are

* Bull. Torrey Club **34**: 351–353. 1907.

† N. C. Geol. Surv., Vol. 3. 552 pp. "1912." (Published about the middle of 1913.)

‡ See Torreya **13**: 139–144. 1913.

§ N. C. Geol. Surv. Bull. 24. 169 pp., 27 pl. 1915.

‖ U. S. Bur. Forestry Bull. 56. 62 pp., 4 plates & map. "1905." See Bull. Torrey Club **34**: 352 (5th footnote), 360 (4th footnote). 1907.

"Norfolk fine sandy loam,"* "Norfolk sandy loam," "Swamp," "Norfolk sand," "Portsmouth fine sandy loam," "Portsmouth sand," "Portsmouth sandy loam," and "Norfolk fine sand"; and in the South Carolina portion "Norfolk sandy loam," "Swamp," "Portsmouth sandy loam," "Norfolk sand," "Coxville fine sandy loam," "Norfolk fine sandy loam," "Portsmouth fine sandy loam," and "Orangeburg fine sandy loam." This sequence should not be taken too literally, for the areas that have been surveyed may not be perfectly typical, and moreover, there are all possible gradations between adjacent soils, and similar soils are very liable to be classified a little differently by different men in neighboring areas, or even by the same men in different years. But it will suffice to show the prevalence of gray sandy loams and of swamps, and the scarcity of reddish and distinctly clayey soils. The reddish "Orangeburg" soils are perceptibly commoner in South Carolina than farther northeast.

The physical composition of the soil may also be illustrated by disregarding the more or less arbitrary series names (thus eliminating much of the "personal equation") and summing up the ten commonest texture classes, with their percentages. As in the plant list farther on, the column of percentages preceding the names is for the whole area, and the others for separate states as indicated.

	Soil types	N. C.	S. C.
31.2	Sandy loam	26.1	37.0
22.4	Fine sandy loam	30.0	12.7
15.0	Sand (including sand-hill)	13.9	16.0
14.0	Swamp, muck, etc.	14.8	12.6
3.8	Fine sand	3.8	3.8
3.0	Clay	1.8	4.2
2.7	Coarse sandy loam	1.5	4.1
2.4	Coarse sand	2.2	2.5
2.3	Loam	1.1	3.8
1.5	Very fine sandy loam	2.1	0.7

* For the benefit of readers who are not familiar with the system of classification used by the U. S. Bureau of Soils it should be explained that the "Norfolk" series includes grayish coastal plain soils with friable yellowish subsoils, the "Orangeburg" gray, red or brownish soils with sandy clay subsoils, and the "Portsmouth" damp blackish more or less peaty soils with flat or slightly depressed surface. "Swamp" is usually applied to permanently saturated soils, but does not include all kinds of swamps, some of which have been described under other names, especially in later years.

Data for estimating the average chemical composition of the soil are rather meager. In the Tenth Census, vol. 6, pp. 504 and 556, are analyses of seven soils from this region (five from North Carolina and two from South Carolina), made by Hilgard's five-day acid digestion method, which seems to give results more consistent with the vegetation and crops than any earlier or later method. Details of the locality, depth, vegetation, etc., of each soil are given in the work mentioned (under Nos. 1 and 9 on page 504 and 11, 13, 15, 17 and 19 on page 556), and need not be repeated here. The averages of the seven analyses are given below. (With so few samples from South Carolina and none from Virginia it would hardly be worth while to give the averages for each state separately.)

	Per cent.
Water and organic matter	2.940
Potash (K_2O)	.125
Soda (Na_2O)	.052
Lime (CaO)	.079
Magnesia (MgO)	.076
Phosphoric acid radicle (P_2O_5)	.082
Sulphuric acid radicle (SO_3)	.085
Brown oxide of manganese (Mn_3O_4)	.068
Peroxide of iron (Fe_2O_3)	1.684
Alumina (Al_2O_3)	3.375
Soluble silica	2.704
Insoluble matter	88.844

These figures of course will mean little to one who is not accustomed to interpreting soil analyses, but those who are sufficiently interested may find it worth while to compare them with similar analyses from other states published in the same work and copied by the writer in recent easily accessible publications.* Even yet the significance of some of the figures cannot be explained, for lack of knowledge of the functions of some of the soil constituents in plant physiology; but there is no doubt that these soils are below the average for the United States in fertility.

It seems very probable that the Virginia portion of this belt has a higher proportion of potassium in its soil than the rest, on account of the proximity to metamorphic rocks and the drier summers, and more humus on account of the richer soil and less

* Bull. Torrey Club **40**: 380–391. 1913; **41**: 555. 1914; Rep. Fla. Geol. Surv. **6**: 195, 230, 269, 328. 1914; **7**: 123. 1915.

frequent fires. South Carolina is probably above the average in calcium, phosphorus and iron, on account of the occurrence of those elements in the underlying strata.

Another pretty good indication of soil fertility or the lack of it is the density of population, proportion of "improved land," and the annual expenditure per acre for fertilizers.* In the table below these data are given for the portions of the belt under consideration in each state, and also for the whole of each state and the United States, as computed from the reports of the 10th and 13th censuses.†

Areas	Inhabitants per square mile		Percentage of improved land		Expenditure for fertilizer per acre	
	1880	1910	1880	1910	1879	1909
Pinus Taeda belt:						
Virginia	29.4	40.7	25.9	28.1	$0.45	$1.89
North Carolina	28.8	42.0	19.8	27.2	.41	2.67
South Carolina	27.5	41.0	18.4	30.0	.73	3.47
Whole states:						
Virginia	37.7	51.2	33.0	38.3	.25	0.70
North Carolina	28.7	45.3	20.8	28.2	.33	1.39
South Carolina	32.0	49.7	21.2	31.3	.64	2.49
Whole United States	16.9	30.9	15.0	25.1	.10	0.24

These statistics ought to make it plain enough that the soil of the *Pinus Taeda* belt is less fertile than the average of the states in which it lies, and that in this belt the soil fertility tends to decrease a little southward. The great increase in the use of fertilizers between 1880 and 1910 probably does not indicate soil exhaustion so much as that the greatly increased output of the nitrate, phosphate and potash mines in other parts of the world, together with the improvement of transportation facilities, makes it possible to cultivate with profit much poorer soils than formerly.

Climate. As far as climate is concerned it will probably suffice for present purposes to give for one station in each state the mean temperature for January, July and the year, in degrees Fahrenheit, the average annual precipitation, in inches, and the

* See Science II. 42: 500–503. Oct. 8, 1915.

† For some similar statistics for other southeastern states and their economic significance, with a map of the pine-barren region, see Journal of Geography 14: 42–48. Oct. 1916.

percentage of it that comes in the four warmest months (June to September) and six warmest months (May to October). The stations selected are Williamsburg, Va., Goldsboro, N. C., and Blackville, S. C., at each of which records have been kept for more than twenty years. The figures have been computed from the annual summaries of the U. S. Weather Bureau for 1913, except that a few obvious typographical errors have been corrected with the aid of the 1912 summaries. There happens to be no station within the Virginia portion of the *Pinus Taeda* belt with a sufficiently complete record, but Williamsburg is only a short distance away, on the north side of the James River.

Stations and length of record	Mean temperature			Average Precipitation		
	Jan.	July	Annual	Annual	4 mos.	6 mos.
Williamsburg, Va., 22 years....	38.4°	76.8°	57.1°	49.18	38.6%	51.9%
Goldsboro, N. C., 44 years.....	42.3°	79.8°	61.1°	51.85	45.0%	60.0%
Blackville, S. C., 25 years.....	46.4°	81.7°	64.4°	47.47	44.3%	58.3%

The milder winter southward is of course not surprising. The proportion of summer rain is higher here than in most places a little farther inland, but lower than in the neighboring Cape Fear pine-barrens.* The wetness of the summers in North Carolina, especially as compared with Virginia, is significant, and helps explain some of the differences in soil and vegetation.

Vegetation. The prevailing type of upland vegetation in this region resembles the typical pine-barrens farther south except in having more *Pinus Taeda* than *Pinus palustris*, more deciduous trees, and more shrubs. The flat areas and shallow depressions previously mentioned generally have either pocosin or cypress pond vegetation, the former being commonest in North Carolina (but more characteristic of the Cape Fear pine-barrens) and the latter in South Carolina.† Both alluvial and non-alluvial swamps,

* For similar data for other places see Bull. Torrey Club **37**: 415–416. 1910; **41**: 556–557. 1914; Rep. Fla. Geol. Surv. **6**: 182–183. 1914.

† The "savannas" described by Chapman and the "bays" described by Coker, in the works on South Carolina vegetation already cited, must be very similar to pocosins, while Chapman's "pocosins" and Coker's "savannas" seem to be essentially cypress ponds. This does not necessarily indicate that these authors used the terms incorrectly, but rather that local usage varies from place to place. Readers who are not familiar with the term "pocosin" can find references in Bull. Torrey Club **37**: 415 (first footnote). 1910; and New Internat. Encyc. II. **18**: 761. 1916.

of several kinds, are of frequent occurrence. There is a little hammock vegetation near some of the streams.

Owing chiefly to the general flatness of the country it is very difficult to draw a sharp line between different habitats or even between upland and lowland vegetation. There are many places where such "xerophytes" as *Pinus palustris*, *Quercus marylandica* and *Aristida stricta* grow within a few feet of moist-pine-barren plants like *Eupatorium rotundifolium*, *Chondrophora nudata* and *Habenaria ciliaris*, apparently in the same soil and with almost exactly the same amount of moisture. The activities of farmers and lumbermen during the last two centuries have complicated matters still further. About 30 per cent. of the area is now under cultivation, and therefore devoid of natural vegetation, considerable areas are occupied only by weeds, and the remaining forests have been robbed of their largest trees. For these reasons, and also because the superficiality of my observations does not warrant attempting such details, the vegetation is studied collectively, without separating the habitats. The frequency of fire has not been specially investigated, but it is doubtless less than in typical pine-barrens. At the present time fire is probably less frequent in any one spot than it was a century ago, on account of the numerous fields, roads, etc., that serve as barriers.

Summary of field work. The plant census below is made up from notes taken on several trips between New York and the states beyond the Savannah River, as follows. The arrangement is chronological, and references to places where some of the trips have been written up are given in parentheses.

June 11, 1903. Suffolk, Va., to Weldon, N. C., by the Seaboard Air Line. (Torreya **3**: 121–123. Aug. 1903.)

Nov. 17, 1905. Laurel Hill to Pembroke, N. C., by the Seaboard Air Line, and back on foot as far as Laurinburg. (Torreya **6**: 41–45. March, 1906.)

July 25, 1906. Savannah River (a few miles below Augusta) to Allendale, S. C., by the Charleston & Western Carolina Ry. (Bull. Torrey Club **34**: 351–377; **37**: 411. The first reference also applies to the other 1906 dates below.)

July 26, 1906. Ashley Junction to Florence, S. C., by the Atlantic Coast Line.

July 27, 1906. Florence, S. C., to Lake Waccamaw, N. C., by the Atlantic Coast Line.

July 28, 1906. Wallace (about 35 miles north of Wilmington) to Rocky Mount, N. C., and Suffolk, Va., by the Atlantic Coast Line.

July 30, 1906. Suffolk to Petersburg, Va., by the Norfolk & Western Ry. (about 47 miles an hour).

July 19, 1908. Suffolk to Emporia, Va., by the Southern Ry. (Torreya **9**: 219–221, 223–226. Nov. 1909.)

July 26, 1909. On the Seaboard Air Line in southwestern South Carolina from the Salkehatchie River to the North Fork of the Edisto. (Bull. Torrey Club **37**: 403–406, 411, 413–414, 418–420. 1910. This covers the work of the next two days also.)

July 27, 1909. Laurel Hill to Rosindale, N. C., by the Seaboard Air Line, and Verona to New Bern by the Atlantic Coast Line.

July 28, 1909. New Bern to Mackey's Ferry, N. C., by the Norfolk & Southern Ry. (now Norfolk Southern R. R.).

March 4, 1910. Perry to Allendale, S. C., by the Southern Ry. (Bull. Torrey Club **38**: 225–226. 1911.)

Aug. 22, 1913. Aiken to Ashley Junction, S. C., by the Southern Ry., with a stop of about an hour at Branchville, which allowed some observations on weeds. (Torreya **16**: 243. 1916.) Ashley Junction to Florence, S. C. (same route as on July 26, 1906) later in the day.

Aug. 23, 1913. Florence, S. C., to Parkton, N. C., and Fayetteville to Selma, N. C., by the Atlantic Coast Line. Selma to Goldsboro by the Southern Ry. Goldsboro to Beaufort, N. C., by the Norfolk Southern R. R., but note-taking interrupted by darkness near Mansfield, about 89 miles from Goldsboro.

Aug. 26, 1913. Beaufort to Kinston, N. C., by the Norfolk Southern R. R., and on foot from Kinston to Dover and the big pocosin near by. (See Pop. Sci. Monthly **85**: 354. Oct. 1914.)

Aug. 27, 1913. Kinston to Halifax, N. C., by the Atlantic Coast Line. (Notes taken later in the day along or near the fall-line north of Halifax are not counted here.)

March 3, 1914. North Fork of the Edisto to the Salkehatchie River in South Carolina, by the same route as on July 26, 1909, at the rate of about 44 miles an hour.

Dec. 16, 1915. Florence, S. C., to Pembroke, N. C., by the Atlantic Coast Line, and on foot along the Seaboard Air Line for a few miles northwest of Pembroke, to get one of the same plants seen there in 1905.

These trips together comprise about 1,560 miles of railroad travel in 53 hours (including perhaps 200 stops of half a minute or more at stations), and 40 miles of walking in 21 hours; and touch about five-sixths of the counties in the whole region. By states the field work might be summed up as follows: Virginia, one day in June and three in July; North Carolina, one in June, four in July, three in August, one in November, one in December; South Carolina, two in March, four in July, two in August, one in December. If observations could have been made in April, May, September and October the list of herbs would be more complete and accurate, but it is not likely that any tree that makes up as much as 1 per cent of the vegetation has been overlooked, except in cases of closely related species that are difficult to distinguish.

Methods of Analysis. Notes on the vegetation were taken on practically every mile, and from these the percentages given below

have been calculated. As car-window notes cannot do justice to the abundance of some of the conifers, I have arbitrarily multiplied my figures for *Pinus Taeda* and *P. palustris* by 5 and for other conifers by 3 before calculating the percentages. The figures for *Cornus florida*, *Salix nigra*, *Oxydendrum*, *Carpinus* and *Planera* have been divided by 2 on account of the small size of those trees, for the object of this study is to analyze the vegetation volumetrically. The figures for a few still smaller trees, or large shrubs (listed after the regular trees) have been divided by 10, those for ordinary shrubs and woody vines by 100, and those for herbs by 500.* Species seen less than five times, which are presumed to make up a wholly insignificant part of the total vegetation, are omitted, as are all bryophytes and thallophytes, which are still smaller and less conspicuous, on the average, than vascular herbs. The fact that nearly all my walking in this region has been done in North Carolina tends to exaggerate the shrubs and herbs in the middle portion, but allowance is made for that in the generalizations which follow the list.

These percentages of course cannot be guaranteed to be accurate within 10 per cent., but they are reasonably consistent with pre-conceived notions and known facts. In C. S. Chapman's report on Berkeley County, S. C., previously mentioned, there is a multitude of detailed statistics from which the percentages of the commoner trees in that particular area can be computed, and that serves as a check on my results. But his figures cannot be taken as representative of the whole *Pinus Taeda* belt, for several reasons. In the first place, his area is too small and too far from the center to be thoroughly typical, and being the property of a lumber company it probably contains more pine than the average. Second, some of the species are wrongly identified,† and some very common ones, such as *Pinus serotina* and *Quercus marylandica*, are omitted from the statistics though mentioned as occurring.

The species are arranged in order of abundance in the region as a whole, but the percentages are given separately for each of the three states involved, in order to bring out certain interesting

* This is a modification of a method described in the 6th Annual Report of the Florida Geological Survey, pp. 177–180.

† See Bull. Torrey Club 34: 352. 1907.

features of local distribution. The total percentage is given first, then the name of the species, its usual habitat in the region, and the percentages for the three states. Percentages too small to be represented without using too many decimal places are replaced by 0, but where a species has not been seen at all in one of the states the space is left blank. Percentages are given for herbs only in the case of a few of the most abundant species, for to attempt it for all of them would be a refinement wholly unwarranted by my crude methods, and would require too long decimals. The highest number in each line, if it is reasonably certain that more thorough exploration will not overturn its plurality, is printed in heavier type, so that the reader can run down one column at a time and pick out the characteristic species for each state. The names of evergreens are printed in heavier type (in the case of semi-evergreens only the specific name), and those of weeds enclosed in parentheses.

LIST OF PLANTS

TREES

			Va.	N. C.	S. C.
46.4	**Pinus Taeda**	Nearly everywhere	**58.1**	49.9	40.4
16.4	**Pinus palustris**	Driest soils	0	12.1	**25.6**
6.2	**Pinus serotina**	Damp sandy places	1.0	**8.3**	4.7
3.7	Taxodium distichum	Richer swamps	**8.7**	3.3	3.1
3.4	Liquidambar Styraciflua	Various habitats	**5.5**	3.7	2.6
3.3	Nyssa biflora	Ponds and swamps	1.8	**4.0**	2.9
3.3	Taxodium ascendens	Ponds and small swamps	—	3.1	**4.5**
1.7	Quercus marylandica	Driest soils	0.8	1.8	1.7
1.6	**Pinus echinata**	Driest soils	**7.8**	0.7	1.3
1.5	Liriodendron Tulipifera	Branch-swamps mostly	**2.5**	1.6	1.3
1.4	Acer rubrum	Swamps	1.0	**1.7**	1.2
1.4	**Magnolia glauca**	Non-alluvial swamps	1.8	1.7	1.1
0.8	Quercus falcata	Dry soils	0.9	1.1	0.4
0.8	Quercus Catesbaei	Dry sandy soils	0.1	0.5	**1.2**
0.6	Nyssa uniflora	Alluvial swamps	**1.9**	0.5	0.5
0.6	Cornus florida	Uplands	**0.9**	0.8	0.3
0.5	Quercus alba	Richer soils	**1.9**	0.7	0.1
0.5	Quercus Phellos	Low grounds mostly	0.3	0.5	0.6
0.5	Salix nigra	Along streams mostly	**0.9**	0.6	0.4
0.4	Quercus **nigra**	Low grounds mostly	0.2	0.3	**0.5**
0.3	Quercus stellata	Uplands	0.2	0.4	0.3
0.3	Betula nigra	Along creeks and rivers	**0.5**	0.3	0.3
0.3	Oxydendrum arboreum	Uplands	**0.6**	0.4	0
0.2	**Ilex opaca**	Hammocks, etc.	**0.6**	0.2	0.2

0.2	Fagus grandifolia	Hammocks, etc.	0.2	0.2	0.1
0.2	(Diospyros virginiana)	Old fields, etc.	0.5	0.2	0.1
0.2	Fraxinus caroliniana	Swamps	—	0.1	0.2
0.1	Quercus Michauxii	Bottoms, etc.	0	0.1	0.2
0.1	Hicoria alba?	Richer soils	—	0.1	0.2
0.1	Hicoria aquatica	Alluvial swamps	0.1	0.1	0.2
0.1	Platanus occidentalis	Alluvial swamps	0.5	0.1	0.1
0.1	Quercus cinerea	Sandy uplands	—	0.1	0.2
0.1	**Gordonia Lasianthus**	Non-alluvial swamps	—	0.2	0
0.1	**Juniperus virginiana**		—	0.1	0.1
0.1	Populus heterophylla	Alluvial swamps	—	0	0.1
0.1	Quercus lyrata	Alluvial swamps	—	0	0.1
0.1	Planera aquatica	Alluvial swamps	—	—	0.2
0.1	**Quercus laurifolia**		—	0	0.1
0	Carpinus caroliniana	Bottoms, etc.	—	0.1	0
	(and about 23 others)				
	SMALL TREES OR LARGE SHRUBS				
.04	(Prunus angustifolia)	Old fields, etc.	0	.03	.05
.02	(Sassafras variifolium)	Old fields, etc.	0	.02	.02
.01	Persea pubescens	Non-alluvial swamps	—	.01	—
	(and 5 others)				
	WOODY VINES				
.005	**Smilax laurifolia**	Non-alluvial swamps	—	.01	0
.001	**(Lonicera japonica)**	Roadsides, etc.	—	0	0
.001	Tecoma radicans		0	0	0
0	Smilax Walteri	Swamps	—	0	0
	(and about 8 others)				
	SHRUBS				
.014	**Arundinaria tecta**	Low grounds	.02	.02	.01
.012	**Myrica cerifera**	Richer soils	.02	.01	.01
.011	Alnus rugosa	Swamps	.02	.01	.01
007	Clethra alnifolia	Damp sandy soils	.01	.01	.01
.007	**Ilex glabra**	Damp sandy soils	.01	.01	0
.006	Cyrilla **racemiflora**	Swamps	—	.01	—
.006	**Phoradendron flavescens**	On hardwood trees	.01	.01	.01
.006	Rhus copallina	Uplands	01.	.01	0
.004	Quercus pumila	Pine-barrens	—	0	.01
.003	**Magnolia glauca***	Low pine-barrens	—	0	0
.002	Liquidambar Styraciflua	Low grounds	0	0	0
.001	Viburnum nudum	Branch-swamps, etc.	—	0	0
.001	Aralia spinosa	Richer soils	—	0	0
.001	**Pieris nitida**	Pocosins, etc.	—	0	0
.001	(Diospyros virginiana)		0	0	0
.001	(Rubus cuneifolius)	Roadsides, etc.	0	0	0
.001	Cephalanthus occidentalis	Swamps and ponds	—	0	0

* See Bull. Torrey Club 34: 371–372. 1907.

.001	**Zenobia cassinifolia**	Pocosins, etc.	—	0	—
.001	Decodon verticillatus	Swamps	—	0	—
.001	**Baccharis halimifolia**	Low grounds	—	0	0
.001	**Myrica pumila**	Pine-barrens	—	0	0
0	**Hypericum fasciculatum**	Cypress ponds, etc.	—	0	0
0	**Ascyrum stans**	Damp sandy places	—	0	—

(and about 25 others)

HERBS

.005	Eupatorium rotundifolium	Low pine land	.001	.005	.005
.003	(Helenium tenuifolium)	Roadsides, etc.	0	.003	.003
.002	**Tillandsia usneoides**	On trees	—	.001	.005
.002	Sarracenia **flava**	Low pine-barrens	—	.003	.001
.002	Chondrophora **nudata**	Low pine-barrens	—	.003	.001
.002	(Leptilon canadense)	Fields and roadsides	0	.002	.001
.001	Pteridium aquilinum	Pine lands	.001	.001	.002
.001	Aristida **stricta***	Pine-barrens	—	.002	0
.001	Polygala lutea	Low pine-barrens	.001	.002	0
.001	Lespedeza capitata sericea	Pine lands	—	.001	.001
.001	(Syntherisma sanguinale)	Fields, etc.	0	.001	.001
.001	(Senecio tomentosus)	Roadsides, etc.	.006	.001	0
.001	Rhexia Alifanus	Low pine-barrens	—	.001	0
.001	**Chrysopsis graminifolia**	Uplands	.001	.001	.001
.001	Scirpus Eriophorum	Low grounds	0	.001	.001
.001	Habenaria ciliaris	Low pine land	0	.001	0
.001	(Euthamia caroliniana)	Roadsides, etc.	—	.001	0
.001	Osmunda cinnamomea	Low grounds	0	.001	.001
.001	Polygala ramosa	Low pine-barrens	0	.001	—
.001	(Ambrosia artemisiifolia)	Fields and roadsides	0	.001	.001
.001	Marshallia graminifolia	Low pine-barrens	—	.001	0
.001	Panicum hemitomon	Shallow ponds, etc.	—	0	.001
0	Campulosus aromaticus	Low pine-barrens	—	.001	0
0	Habenaria blephariglottis	Edges of swamps	—	.001	—
0	Erianthus sp.	Pine woods	—	.001	0
0	Eriocaulon **decangulare**	Low pine-barrens	—	.001	0
0	Anchistea virginica	Around ponds, etc.	—	.001	0
0	Afzelia cassioides	Pine lands	—	0	.001
0	Lilium Catesbaei	Low pine-barrens	—	.001	0
0	Polygala **cymosa**	Cypress ponds	—	0	.001
0	(Acanthospermum australe)	Roadsides, etc.	0	.001	0
0	Andropogon scoparius?	Uplands	0	0	.001
0	Eupatorium purpureum	Branch-swamps	0	0	0
0	Vernonia angustifolia	Dry pine-barrens	—	0	0
0	**Nymphaea sagittifolia**	Creeks and small rivers	—	.001	0
0	(Rhynchospora inexpansa)	Low grounds	.001	.001	—
0	Mesadenia lanceolata	Low pine-barrens	—	—	.001
0	Xyris sp.	Low pine lands	.001	0	0

* See Bull. Torrey Club 37: 601–602. 1911.

o	(Stenophyllus floridanus)	Cultivated fields	—	—	.001
o	Oxypolis filiformis	Cypress ponds, etc.	—	o	o
o	Pontederia cordata	Cypress ponds, etc.	—	o	o
o	Typha latifolia	Marshes and ditches	o	o	o
o	(Diodia teres)	Roadsides, etc.	—	o	o
o	(Gnaphalium obtusifolium)	Old fields	—	o	.001
o	Eupatorium verbenaefolium	Low pine land	—	o	—
o	Andropogon sp.		—	o	o
o	Habenaria cristata?	Low pine land	—	o	o
o	(Agalinis fasciculata?)	Old fields	—	o	o
o	Solidago sp.		—	o	o
o	(Chaetochloa sp.)		—	o	o
o	Rhynchospora axillaris	Low pine-barrens	—	o	—
o	(Eupatorium capillifolium)		.001	o	o
o	(Lespedeza striata)	Roadsides, etc.	—	o	o
o	Ludwigia pilosa	Ponds, etc.	—	o	o
o	Andropogon glomeratus?	Low grounds	—	o	o
o	Ionactis linariifolius	Dry woods	—	o	o
o	Monarda punctata		—	o	—
o	Carphephorus bellidifolius?	Pine lands	—	o	—
o	Agalinis linifolia	Cypress ponds	—	o	o
o	(Eupatorium compositifolium)	Roadsides, etc.	—	o	o
o	(Sarothra gentianoides)	Old fields, etc.	—	o	o
o	**Lycopodium alopecuroides**	Low pine-barrens	—	o	—
o	Mikania scandens	Swamps	—	o	o
o	Laciniaria spicata?	Low pine-barrens	—	o	o
o	Zygadenus glaberrimus	Low pine-barrens	—	o	o
o	(Sida rhombifolia)	Roadsides, etc.	—	o	o
o	Mesosphaerum radiatum	Low pine-barrens	—	—	o
o	Iris **versicolor**	Low grounds	o	o	—
o	Helianthus angustifolius	Low pine land	—	o	—
o	(Chamaecrista fasciculata)	Old fields, etc.	—	o	o
o	(Polypremum procumbens)	Roadsides, etc.	—	o	o
o	Eriogonum **tomentosum**	Dry sand	—	—	o
o	Sabbatia lanceolata	Low pine-barrens	—	o	—
o	Dichromena latifolia	Low pine-barrens	—	o	o
o	Rhynchospora corniculata	Low grounds	o	o	o
o	Erianthus strictus	Low grounds	—	o	o
o	Juncus scirpoides	Low grounds	—	o	—
o	Cicuta Curtissii	Low grounds	o	o	—
o	(Cyperus rotundus)	Fields, etc.	—	o	o
o	Rhexia mariana?	Low grounds	o	o	—
o	**Nymphaea fluviatilis**?	River-swamps	—	o	o
o	Silphium compositum?	Dry pine land	o	o	o
o	Iris tripetala	Low grounds	—	o	—
o	Sarracenia purpurea	Pocosins, etc.	—	o	—

(and about 160 others)

Just how much a census taken at the time of the discovery of America would have differed from this it is impossible to say. It is very likely, however, that *Pinus Taeda* has replaced *P. palustris* to a considerable extent through the influence of civilization, as claimed by Ashe and others; one of the reasons for the change probably being the diminishing frequency of fire, for *P. Taeda* is more sensitive to fire than *P. palustris* is.

The percentages of evergreens are for Virginia 69.4, North Carolina 73.6, South Carolina 75.7, and for the whole region 74.0. The correspondence between these figures is close enough to give confidence in the method used, and at the same time the differences are just what one would expect from the slight differences in soil fertility in the three states already pointed out.*

So many of the Ericaceae and Leguminosae are not readily recognizable from a moving train that it is hardly worth while to attempt to give statistics for these plants for each state separately, but for the whole region the proportion of Clethraceae, Ericaceae and Vacciniaceae among the shrubs seems to be about 12 per cent. and of Leguminosae and allied families among the herbs about 4 per cent. The figure for Ericaceae is the same as that already obtained for northern Florida† while that for Leguminosae is lower. It is reasonably certain that the Ericaceae are most abundant in North Carolina and the Leguminosae in South Carolina.

By contrasting the more characteristic plants of each division we can get some interesting facts. In the following table the species which are most abundant in the Virginia portion are listed in the first column, the same for North Carolina in the second, and for South Carolina in the third. They are arranged in order of abundance, just as in the preceding table. Those starred seem to be at least twice as abundant in the state indicated as in either of the other two.

This table confirms in a general way observations of a similar nature made in passing through the same three states in 1906, but taking in a larger and more diversified area.‡ The proportion

* Previous estimates of evergreen percentages for parts of the Carolina coastal plain (summarized in Bull. Torrey Club 41: 563–564. 1914) are now believed to be too low.

† Ann. Rep. Fla. Geol. Surv. 6: 395. 1914.

‡ Bull. Torrey Club 34: 363–366. 1907.

VIRGINIA	NORTH CAROLINA	SOUTH CAROLINA
	Trees	
Pinus Taeda	*Pinus serotina	*Pinus palustris
*Taxodium distichum	Nyssa biflora	Taxodium ascendens
Liquidambar Styraciflua	Acer rubrum	*Quercus Catesbaei
*Pinus echinata	*Gordonia Lasianthus	Quercus nigra
*Liriodendron Tulipifera		Fraxinus caroliniana
Cornus florida		Quercus Michauxii
*Nyssa uniflora		Hicoria alba?
*Quercus alba		Hicoria aquatica
Salix nigra		Quercus cinerea
Oxydendrum arboreum		Populus heterophylla
Betula nigra		*Planera aquatica
*Ilex opaca		*Quercus lyrata
Diospyros virginiana		Juniperus virginiana
*Platanus occidentalis		Quercus laurifolia
	Small trees	
	*Persea pubescens	Prunus angustifolia
	Vines	
	*Smilax laurifolia	Tecoma radicans
	Smilax Walteri	
	Shrubs	
Myrica cerifera	Ilex glabra	Phoradendron flavescens
*Alnus rugosa	*Cyrilla racemiflora	*Quercus pumila
Rhus copallina	Magnolia glauca	Diospyros virginiana
Liquidambar Styraciflua	*Viburnum nudum	Baccharis halimifolia
	Aralia spinosa	*Hypericum fasciculatum
	*Pieris nitida	
	*Zenobia cassinifolia	
	Decodon verticillatus	
	*Ascyrum stans	
	Herbs	
*Senecio tomentosus	*Sarracenia flava	Helenium tenuifolium
Eupatorium capillifolium	*Chondrophora nudata	*Tillandsia usneoides
	Leptilon canadense	*Pteridium aquilinum
	*Aristida stricta	*Chrysopsis graminifolia
	*Polygala lutea	*Scirpus Eriophorum
	Lespedeza capitata sericea	Osmunda cinnamomea
	*Rhexia Alifanus	Ambrosia artemisiifolia
	*Habenaria ciliaris	*Panicum hemitomon
	*Euthamia caroliniana	Afzelia cassioides
	*Polygala ramosa	Polygala cymosa
	*Marshallia graminifolia	Andropogon scoparius?
	*Campulosus aromaticus	Mesadenia lanceolata
	*Habenaria blephariglottis	Stenophyllus floridanus
	*Eriocaulon decangulare	Oxypolis filiformis
	*Anchistea virginica	Typha latifolia
	*Lilium Catesbaei	Diodia teres
	(and 24 others)	(and 12 others)

of trees is evidently highest in Virginia, and of shrubs and perhaps herbs in North Carolina.

Without taking up undue space by considering each species separately, it may be said that those in the Virginia list are mostly species that prefer soils richer in potash or humus than the average of the region.* Those in the North Carolina list are largely plants of moist pine-barrens or sandy or peaty bogs, called "bog xerophytes" by some American ecologists, and "oxylophytes" by Warming. Some of those in the South Carolina list may be restricted in their northward distribution by temperature, as suggested in 1907. Others are characteristic of cypress ponds, and some apparently prefer more ferruginous or phosphatic soils than the average of the region. (This may apply especially to the genus *Quercus*, of which there is one in the first column, none in the second, and seven in the third.) Some of the herbs are weeds, but just why weeds should be more abundant in South Carolina is not apparent. It is probably by such comparisons as these, preceded by careful analyses of environmental factors, that we can make the most progress in discovering just what is the optimum environment for each species.

Volumetric and dynamic studies. From reports of foresters on more or less similar areas (which need not be cited here), the stand of timber at the present time may be estimated roughly as 6,000 board feet of lumber per acre. This is equivalent to 500 cubic feet; but to make allowance for slabs, sawdust, tops, saplings, bushes, etc., the latter figure should be just about doubled, making 1,000 cubic feet of wood per acre.

The average increment of partly culled forests of *Pinus Taeda* is at least 3 per cent. annually, and as that is the most abundant species in the region under consideration we will not be far wrong if we take 3 per cent. for the annual increment of the whole vegetation, which would make 30 cubic feet of wood per acre per year.

The dry wood of *Pinus Taeda* weighs 34 pounds per cubic foot, according to Sargent, but that of most of the other trees is

* Several of the same species were found a few years ago to be more abundant in the pine-barrens of Mississippi than in those of Georgia; doubtless for similar reasons. See Bull. Torrey Club 41: 563. 1914.

heavier, so that we will assume the average weight to be 37 pounds, and that of the woody increment 1,110 pounds per acre.

The percentage of ash in the wood is 0.26 in *Pinus Taeda*, but more in most of the other trees, say 0.32 on the average, which would make over three pounds of mineral matter taken each year from the soil by the wood alone. As the inorganic constituents of plants are chiefly concentrated in leaves and bark, and the herbs, which are renewed from the ground up every year, probably take as much from the soil per acre per year in such open forests as the trees do, we may safely multiply the last figure by forty or fifty, making something like 150 pounds per acre (equivalent to a layer of soil about 0.0005 inch deep) for the annual draft on the soil.

This is less than is taken from the soil by the average cultivated crop, even without fertilization, and it all goes back to the soil in the course of time, except what is removed by lumbermen and grazing animals or carried away by streams. Fire, though it destroys the humus and thus dissipates the nitrogen, at the same time accelerates the return of the mineral substances to the soil, and thus enables forests of the pine-barren type to do a large business on a small capital, so to speak. The gradual erosion of the whole surface, continually exposing deeper layers of soil, is probably sufficient to counteract the leaching and keep the soils from becoming steadily poorer.

The amount of water evaporated by average vegetation in moderately humid regions is said to be about 700 pounds to one pound of dry vegetable tissue, and if the total amount of vegetable matter produced in a year is four times the amount of new wood estimated above, or 4,440 pounds per acre, the water required for the region in question would be 3,108,000 pounds per acre, equivalent to about 16 inches of rain, or less than half as much as would evaporate from open water in that climate.*

The foregoing estimates are only crude approximations, but probably lie somewhere between half and double the correct figures; and when such a method is applied with skill and patience to the vegetation of different regions, or different habitats in the same region, it ought to yield some extremely significant results.

COLLEGE POINT, NEW YORK

* See Transeau, Am. Nat. 39: 885; Rep. Mich. Acad. Sci. 7: 74. 1905.

INDEX TO AMERICAN BOTANICAL LITERATURE

1914-1916

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card issue should be addressed to the Treasurer of the Torrey Botanical Club.

Allen, C. E. Four-lobed spore mother cells in *Catharinea*. Am. Jour. Bot. 3: 456–460. *f. 1, 2.* 20 O 1916.

Babcock, E. B. Studies in *Juglans*—III. (1) Further evidence that the oak-like walnut originates by mutation. (2) A parallel mutation in *Juglans Hindsii* (Jepson) Sargent. Univ. Calif. Publ. Agr. 2: 71–80. *pl. 20, 21.* 20 S 1916.

Bailey, L. H. Standard Cyclopedia of Horticulture 5: 2423–3041. *pl. 81–90* + *f. 2694–3515.* New York. 1916.

Barnhart, J. H. Bibliography: volume 9. N. Am. Fl. 9: 427–459. 10 O 1916

Includes the families Agaricaceae, Boletaceae and Polyporaceae.

Braun, E. L. The physiographic ecology of the Cincinnati region. Ohio Biol. Surv. Bull. 7: 115–211. *f. 1–59.* Je 1916.

Britton, N. L. *Anthurium grandifolium.* Addisonia 1: 53, 54. *pl. 27.* 30 S 1916.

Britton, N. L. *Sisyrinchium bermudiana.* Addisonia 1: 43, 44. *pl. 22.* 30 S 1916.

Britton, N. L. Studies on West Indian plants—VIII. Bull. Torrey Club 43: 441–469. 20 O 1916.

Includes descriptions of 46 new species.

Britton, N. L. A white pine planting. Jour. N. Y. Bot. Gard. **17**: 152–154. 14 O 1916.

Brooks, S. C. New determinations of permeability. Proc. Nat. Acad. Sci. **2**: 569–574. *f. 1–6.* 15 O 1916

Burt, E. A. The Thelephoraceae of North America—VI. *Hypochnus.* Ann. Missouri Bot. Gard. **3**: 203–241. *f. 1–30.* Ap 1916;—VII. *Septobasidium.* Ann. Missouri Bot. Gard. **3**: 319–343. *f. 1–14.* S 1916.

Includes twenty-one new species and several new combinations.

Christensen, C. *Maxonia*, a new genus of tropical American ferns. Smithsonian Misc. Col. **66**: 1–4. 30 S 1916.

Clements, F. C. Plant succession. An analysis of the development of vegetation. Carnegie Inst. Publ. **242**: i–xiii + 1–512. *pl. 1–61* + f. *1–51.* 28 Au 1916.

Clinton, G. P. Report of the botanist for 1915. Notes on plant diseases of Connecticut. Rep. Connecticut Agr. Exp. Sta. **1915**: 421–513. *pl. 17–28.* Au 1916.

Clokey, I. W. A new hybrid *Carex* from the middle western states. Torreya **16**: 199–201. 14 S 1916.

Coley, W. S. An early flowering of *Rudbeckia hirta.* Rhodora **18**: 212. 2 O 1916.

Culpepper, C. W., Foster, A. C., & Caldwell, J. S. Some effects of the blackrot fungus, *Sphaeropsis malorum*, upon the chemical composition of the apple. Jour. Agr. Research **7**: 17–40. 2 O 1916.

Detwiler, S. B. The bald cypress (*Taxodium distichum*). Identification and characters. Am. Forestry **22**: 577–581. O 1916. [Illust.]

Doering, A., & Lorentz, P. G. Recuerdos de la expedición al Rió Negro (1879). Bol. Acad. Nac. Cien. Córdoba **21**: 301–386. 1916.

Dunn, G. A. A study of the development of *Dumontia filiformis*—I. The development of the tetraspores. Plant World **19**: 271–281. *f. 1, 2.* S 1916.

Dunnicliff, A. A. Fecundity and stamina. Jour. Heredity **7**: 443–446. O 1916.

Emig, W. H. The occurrence in nature of certain yeast-like fungi with reference to their possible pathogenicity in the higher animals. Ann. Missouri Bot. Gard. **3**: 243–307. *f. 1–13.* Ap 1916.

Gile, P. L., & Carrero, J. O. Immobility of iron in the plant. Jour. Agr. Research **7**: 83–87. 9 O 1916.

Glaser, O. C. The theory of autonomous folding in embryogenesis. Science II. **44**: 505–509. *f. 1, 2.* 6 O 1916.

Goodspeed, T. H., & Ayres, A. H. On the partial sterility of *Nicotiana* hybrids made with *N. sylvestris* as a parent—II. Univ. Calif. Publ. Bot. **5**: 273–290. *pl. 36.* 4 O 1916.

Greenman, J. M. A new *Senecio* from Jamaica. Ann. Missouri Bot. Gard. **3**: 201, 202. Ap 1916.
Senecio Hollickii Britton.

Haas, A. R. The acidity of plant cells as shown by natural indicators. Jour. Biol. Chem. **27**: 233–241. O 1916.

Haas, A. R. The excretion of acids by roots. Proc. Nat. Acad. Sci. **2**: 561–566. O 1916.

Haas, A. R. The permeability of living cells to acids and alkalies. Jour. Biol. Chem. **27**: 225–232. O 1916.

Hagen, I. A correction in nomenclature. Bryologist **19**: 70. 4 O 1916.

Harris, J. A. A quantitative study of the factors influencing the weight of the bean seed—II. Correlation between number of pods per plant and seed weight. Bull. Torrey Club **43**: 485–494. *f. 1–4.* 20 O 1916.

Harris, J. A., & Lawrence, J. V. On the osmotic pressure of the tissue fluids of Jamaican Loranthaceae parasitic on various hosts. Am. Jour. Bot. **3**: 438–454. *f. 1, 2.* 20 O 1916.

Hill, E. J. *Fossombronia crispula* in the dune region of Indiana. Bryologist **19**: 67, 68. 4 O 1916.

Hoar, C. S. The anatomy and phylogenetic position of the Betulaceae. Am. Jour. Bot. **3**: 415–435. *pl. 16–19.* 20 O 1916.

Holman, R. M. Influence of the medium upon the orientation of secondary terrestrial roots. Am. Jour. Bot. **3**: 407–414. *f. 1–3.* 20 O 1916.

Jeffrey, E. C., & Cole, R. D. Experimental investigations on the genus *Drimys*. Ann. Bot. **30**: 359–368. *pl. 7.* Jl 1916.

Kaiser, G. B. Mosses rare in Philadelphia. Bryologist **19**: 69. 4 O 1916.

Kennedy, G. G. Some historical data regarding the sweet bay and its station in Cape Ann. Rhodora **18**: 205–212. 2 O 1916.

Kiesselbach, T. A. Transpiration as a factor in crop production. Nebraska Agr. Exp. Sta. Research Bull. 6: 1–214. *pl. 1–4 + f. 1–24.* 20 Je 1916.

Knowlton, C. H., & Deane, W. Report on the flora of the Boston District—XXIV. Rhodora **18**: 213–221. 2 O 1916;—XXV. Rhodora **18**: 248–252. D 1916.

Knowlton, F. H. A new fossil *Selaginella* from the lower Tertiary of Montana. Torreya **16**: 201–204. *pl. 1.* 14 S 1916.
Selaginella Collieri sp. nov.

Kraus, E. J. Variation of internal structure of apple varieties. Oregon Agr. Exp. Sta. Hort. Bull. 135: 1–42. *pl. 1–31* + *f. 1.* Je 1916.

Kraus, E. J., & Ralston, G. S. The pollination of the pomaceous fruits —III. Gross vascular anatomy of the apple. Oregon Agr. Exp. Sta. Hort. Bull. 138: 1–12. *pl. 1–8.* My 1916.

Lipman, C. B., Burgess, P. S., & Klein, M. A. Comparison of the nitrifying powers of some humid and some arid soils. Jour. Agr. Research **7**: 47–82. 9 O 1916.

Loeb, J. Antagonistic salt action as a diffusion phenomenon. Science II. **44**: 574–576. 20 O 1916.

Macbride, J. F. The true Mertensias of western North America. Contr. Gray Herb. II. **48**: 1–20. Au 1916.
Four new species are described.

Macbride, J. F. Revision of the genus *Oreocarya*. Cotnr. Gray Herb. II. **48**: 20–38. Au 1916.
Three new species are described.

Macbride, J. F. Notes on certain Boraginaceae. Contr. Gray Herb. II. **48**: 39–58. Au 1916.
Includes *Amblynotopsis* gen. nov. and eight new species in *Luppula* (2), *Amblynotopsis* (1), *Cryptantha* (2), *Amsinckia* (1), *Mertensia* (1), and *Lithospermum* (1).

MacCaughey, V. The seaweeds of Hawaii. Am. Jour. Bot. **3**: 474–479. 20 O 1916.

Mansfield, W. Histology of medicinal plants. i–xi + 1–305. *pl. 1–127* + *f. 1–54.* New York. 1916.

McClelland, C. K. On the regularity of blooming in the cotton plant. Science II. **44**: 578–581. *f. 1, 2.* 20 O 1916.

Millspaugh, C. F. Contributions to North American Euphorbiaceae —VI. Field Mus. Nat. Hist. Publ. Bot. **2**: 401–420. Ap 1916.
Includes descriptions of fifteen new species in *Chamaesyce* (9), *Acalypha* (2), *Croton* (3), and *Tragia* (1).

Millspaugh, C. F. *Pedilanthus Smallii.* Addisonia **1**: 47, 48. *pl. 24.* 30 S 1916.

Millspaugh, C. F. Vegetation of Alacran reef. Field Mus. Nat. Hist. Publ. Bot. **2**: 321–431. Ap 1916. [Illust.]

Moxley, G. L. *Lunularia cruciata* (L.) Dumort., in the open. Bryologist **19**: 70. 4 O 1916.

Murrill, W. A. Agaricales. Agaricaceae (pars). Agariceae (pars). N. Am. Fl. **9**: 375–426. 10 O 1916.

Includes sixteen new species in *Hydrocybe* (1), *Comarophyllus* (1), *Hygrophorus* (1), and *Clitocybe* (13).

Murrill, W. A. Collecting fungi in the Catskills. Jour. N. Y. Bot. Gard. **17**: 154, 155. 14 O 1916.

Nash, G. V. *Begonia Williamsii.* Addisonia **1**: 57, 58. *pl. 29.* 30 S 1916.

Nash, G. V. *Columnea hirta.* Addisonia **1**: 45. *pl. 23.* 30 S 1916.

Nash, G. V. *Epidendrum paleaceum.* Addisonia **1**: 55, 56. *pl. 28.* 30 S 1916.

Nash, G. V. *Oncidium urophyllum.* Addisonia **1**: 59, 60. *pl. 30.* 30 S 1916.

Nieuwland, J. A. Critical notes on new and old genera of plants—IX. Am. Mid. Nat. **4**: 500, 501. S 1916.

O'Gara, P. J. Occurrence of yellow leaf rust of wheat (*Puccinia glumarum*) in the Salt Lake Valley, Utah. Science II. **44**: 610, 611. 27 O 1916.

Osterhout, G. E. Is *Carex undulatus* Nutt. found in Colorado? Torreya **16**: 204, 205. 14 S 1916.

Overholts, L. O. The Polyporaceae of the middle-western United States. Washington Univ. Stud. 3: 1–98. *pl. 1–8.* Jl 1915.

Overholts, L. O. A re-description of *Tricholoma praemagnum*, a fairy-ring mushroom. Torreya **16**: 197–199. *f. 3, 4.* 14 S 1916.

Parish, S. B. Plant ecology and floristics of Salton Sink. [In MacDougal, D. T., The Salton Sea.] Carnegie Inst. Publ. **193**: 85–114. 30 Je 1914.

Pickett, F. L. The wandering tapetal nuclei of *Arisaema.* Am. Jour. Bot. **3**: 461–469. *pl. 20* + *f. 1–7.* 20 O 1916.

Pulling, H. E. The angular micrometer and its use in delicate and accurate microscopic measurements. Am. Jour. Bot. **3**: 393–406. *f. 1–4.* 20 O 1916.

Ramaley, F. Dry grassland of a high mountain park in northern Colorado. Plant World **19**: 249–270. *f. 1–6.* S 1916.

Ramaley, F. Mushroom fairy rings of *Tricholoma praemagnum.* Torreya **16**: 193–196. *f. 1, 2.* 14 S 1916.

Rendle, A. B. Botany and its economic applications. Science II. **44**: 547–557. 20 O 1916.

Ricker, P. L. Two types of variable pubescence on plants. Am. Jour. Bot. **3**: 470–473. 20 O 1916.

Rigg, G. B. The toxicity of bog water. Am. Jour. Bot. **3**: 436, 437. 20 O 1916.

Robinson, B. L. A notable monstrosity of *Arisaema triphyllum*. Rhodora **18**: 222, 223. *f. 1*. 2 O 1916.

Rose, J. N. *Cremnophila nutans*. Addisonia **1**: 49. *pl. 25*. 30 S 1916.

Rusby, H. H. The influence of radioactive earth on plant growth and crop production. Radium **4**: 68–74. Ja 1915;—II. Radium **4**: 94–104. F 1915.

Scott, L. B. Forgotten bud variations. Jour. Heredity **7**: 452–455. *f. 6, 7*. O 1916.

Skottsberg, C. Botanische Ergebnisse der schwedischen Expedition nach Patagonien und dem Feuerlande 1907–1909—IV. Studien über die Vegetation der Juan Fernandez-inseln. Kungl. Svensk. Vetenskapsakad. Handl. **51**: 1–73. *pl. 1–7* + *f. 1–12*. 1914.

Small, J. K. *Pithecolobium guadalupense*. Addisonia **1**: 51, 52. *pl. 26*. 30 S 1916.

Smith, E. F. Tumors in plants. Science II. **44**: 611, 612. 27 O 1916.

Smith, G. M. Cytological studies in the Protococcales—I. Zoospore formation in *Characium Sieboldii* A. Br. Ann. Bot. **30**: 459–466. *pl. 11* + *f. 1, 2*. Jl 1916;—II. Cell structure and zoospore formation in *Pediastrum Boryanum* (Turp.) Menegh. Ann. Bot. **30**: 467–479. *pl. 12* + *f. 1–4*. Jl 1916.

Smith, G. M. New or interesting algae from the lakes of Wisconsin. Bull. Torrey Club **43**: 471–483. *pl. 24–26*. 20 O 1916.

Includes descriptions of eleven new species in *Chaetosphaeridium* (1), *Kirchneriella* (1), *Schroederia* (1), *Gloeocystopsis* (1), *Pediastrum* (1), *Peroniella* (1), *Tetraedron* (1), *Actinastrum* (1), *Spirulina* (1), *Anabaena* (1), and *Lyngbya* (1) and the new genus *Gloeocystopsis*.

Stakman, E. C., & Levine, M. N. Rye smut. Minnesota Agr. Exp. Sta. Bull. 160: 1–19. *f. 1–6*. Au 1916.

Stout, A. B. The intermittent annual growth of woody plants. Jour. N. Y. Bot. Gard. **17**: 147–152. *pl. 178*. 14 O 1916.

Swingle, D. B., & Welch, H. Poisonous plants and stock poisoning on the ranges of Montana. Montana Agr. Exp. Sta. Circ. 51: 1–95. *f. 1–11*. Ja 1916.